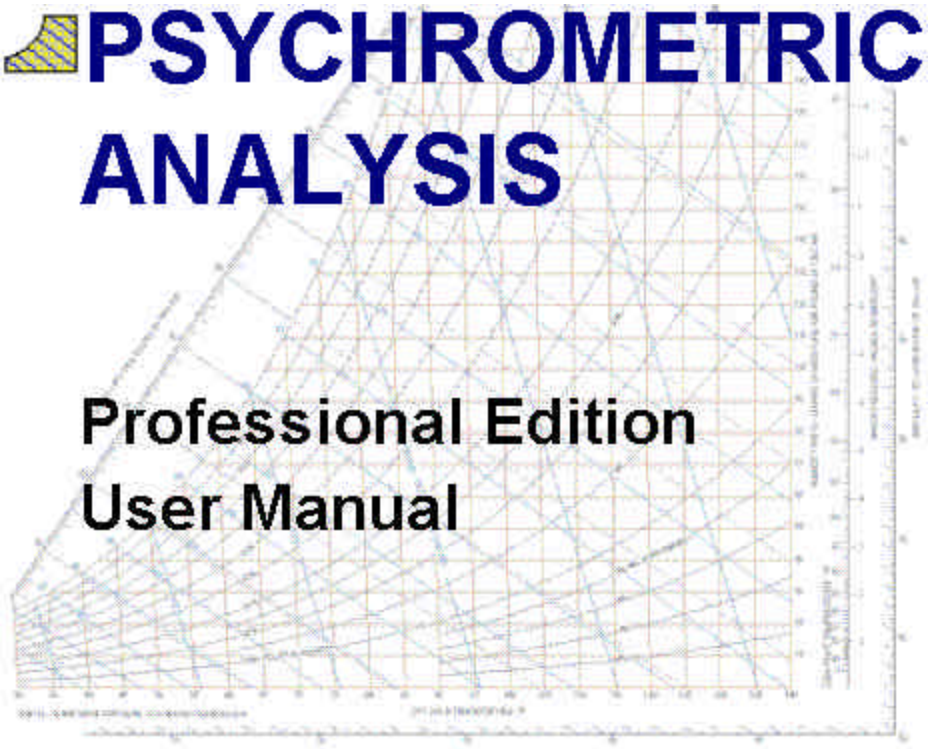
PSYCHROMETRIC ANALYSIS



Professional Edition User Manual

VERSION 5

Authored By:

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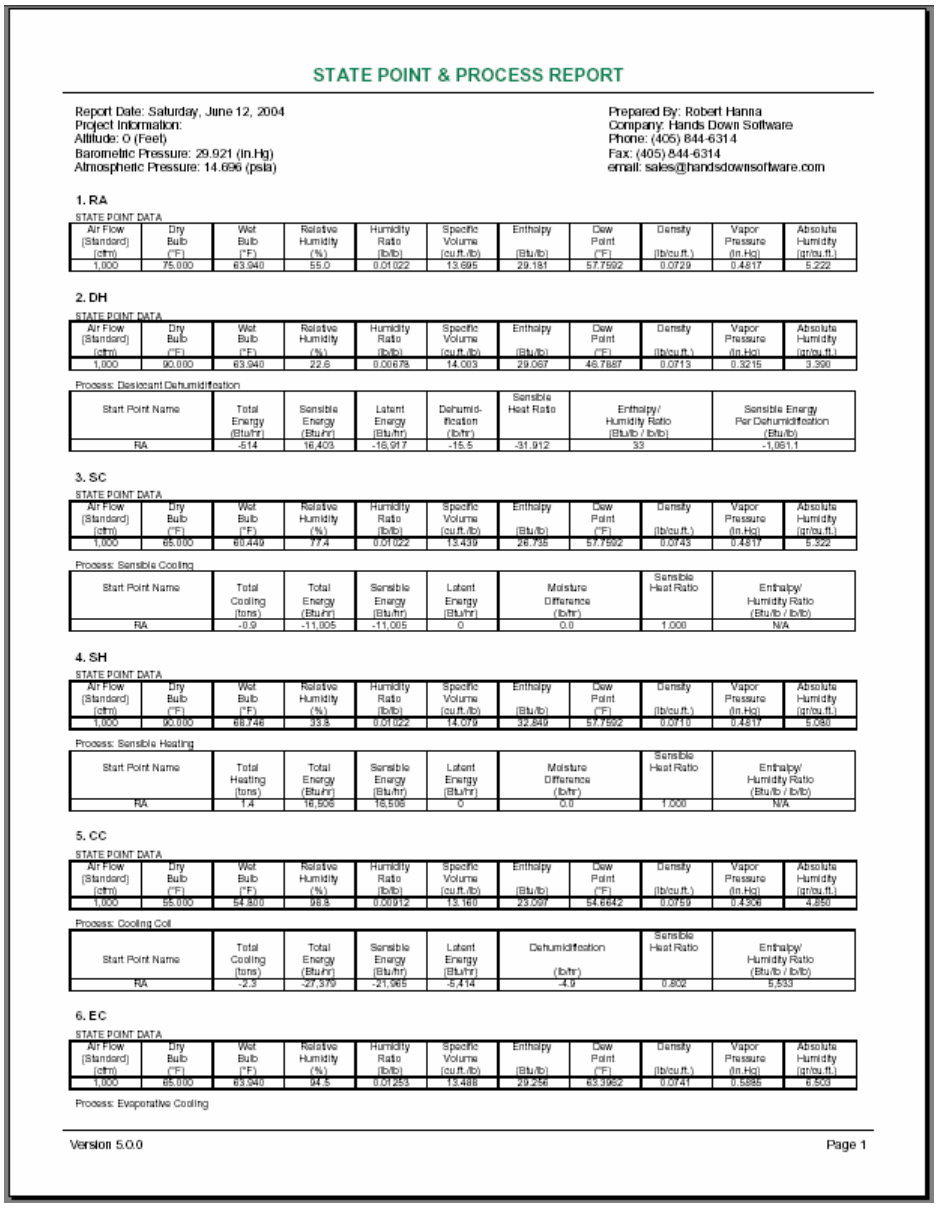
PROGRAM FEATURES

Complete state point and process report with the ability to copy EITHER the report IMAGE or the DATA to the clipboard so you can paste it right into your proposals, presentations or the data into spreadsheets!!



STATE POINT & PROCESS REPORT

Report Date: Saturday, June 12, 2004
Project Information:
Altitude: 0 (Feet)
Barometric Pressure: 29.921 (In.Hg)
Atmospheric Pressure: 14.696 (psia)

Prepared By: Robert Hanna
Company: Hands Down Software
Phone: (405) 844-6314
Fax: (405) 844-6314
email: sales@handsdownsoftware.com

1. RA

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	75.000	63.940	55.0	0.01022	13.695	29.181	57.7592	0.0729	0.4817	5.222

2. DH

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	90.000	63.940	22.6	0.00678	14.003	29.067	48.7687	0.0713	0.3215	3.398

Process: Desiccant Dehumidifcation

Start Point Name	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Dehumid-ification (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)	Sensible Energy Per Dehumidifcation (Btu/lb)
RA	-514	16,403	-16,917	-15.5	-31.912	33	-1,051.1

3. SC

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	65.000	60.449	77.4	0.01022	13.439	26.735	57.7592	0.0743	0.4817	5.322

Process: Sensible Cooling

Start Point Name	Total Cooling (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Moisture Difference (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	-0.9	-11,005	-11,005	0	0.0	1.000	N/A

4. SH

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	90.000	68.746	33.8	0.01022	14.079	32.849	57.7592	0.0710	0.4817	5.080

Process: Sensible Heating

Start Point Name	Total Heating (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Moisture Difference (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	1.4	16,506	16,506	0	0.0	1.000	N/A

5. CC

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	55.000	54.800	98.8	0.00912	13.160	23.097	54.6642	0.0759	0.4306	4.850

Process: Cooling Coil

Start Point Name	Total Cooling (tons)	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Dehumidifcation (lb/hr)	Sensible Heat Ratio	Enthalpy/ Humidity Ratio (Btu/lb / lb/lb)
RA	-2.3	-27,379	-21,965	-5,414	-4.9	0.802	5,533

6. EC

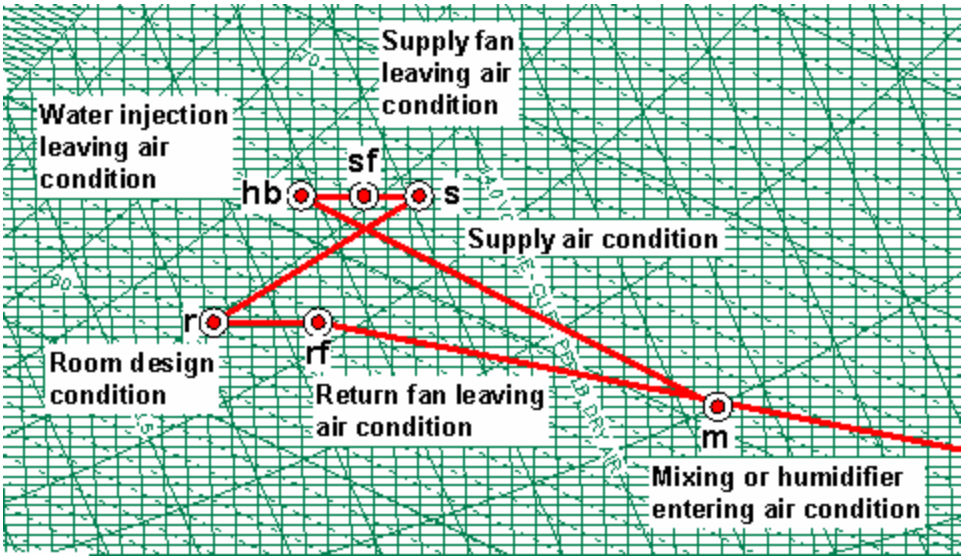
STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (lb/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (In.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	65.000	63.940	94.5	0.01253	13.488	29.256	63.3962	0.0741	0.5885	6.503

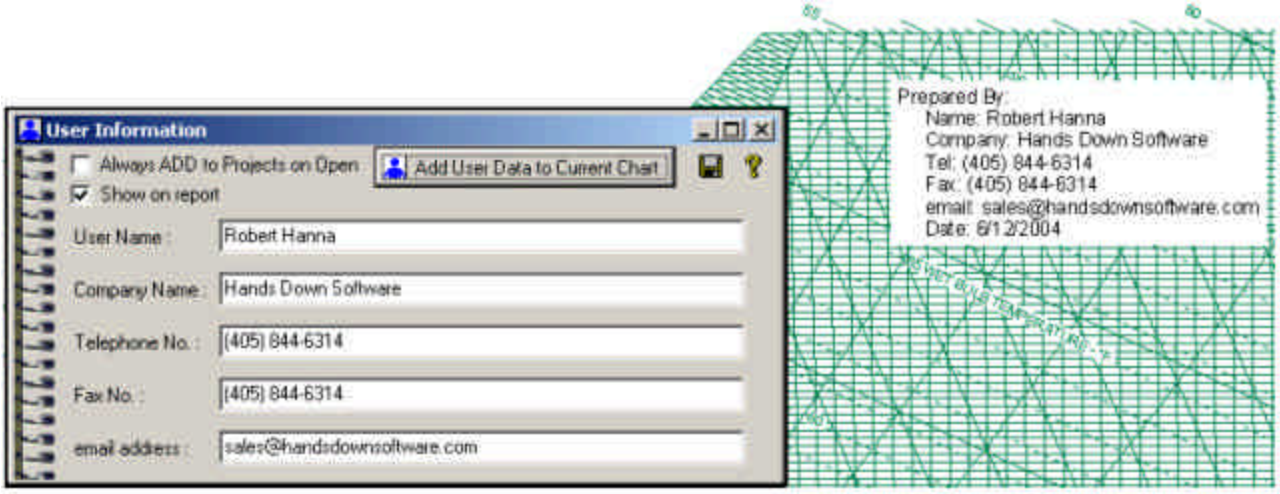
Process: Evaporative Cooling

Version 5.0.0 Page 1

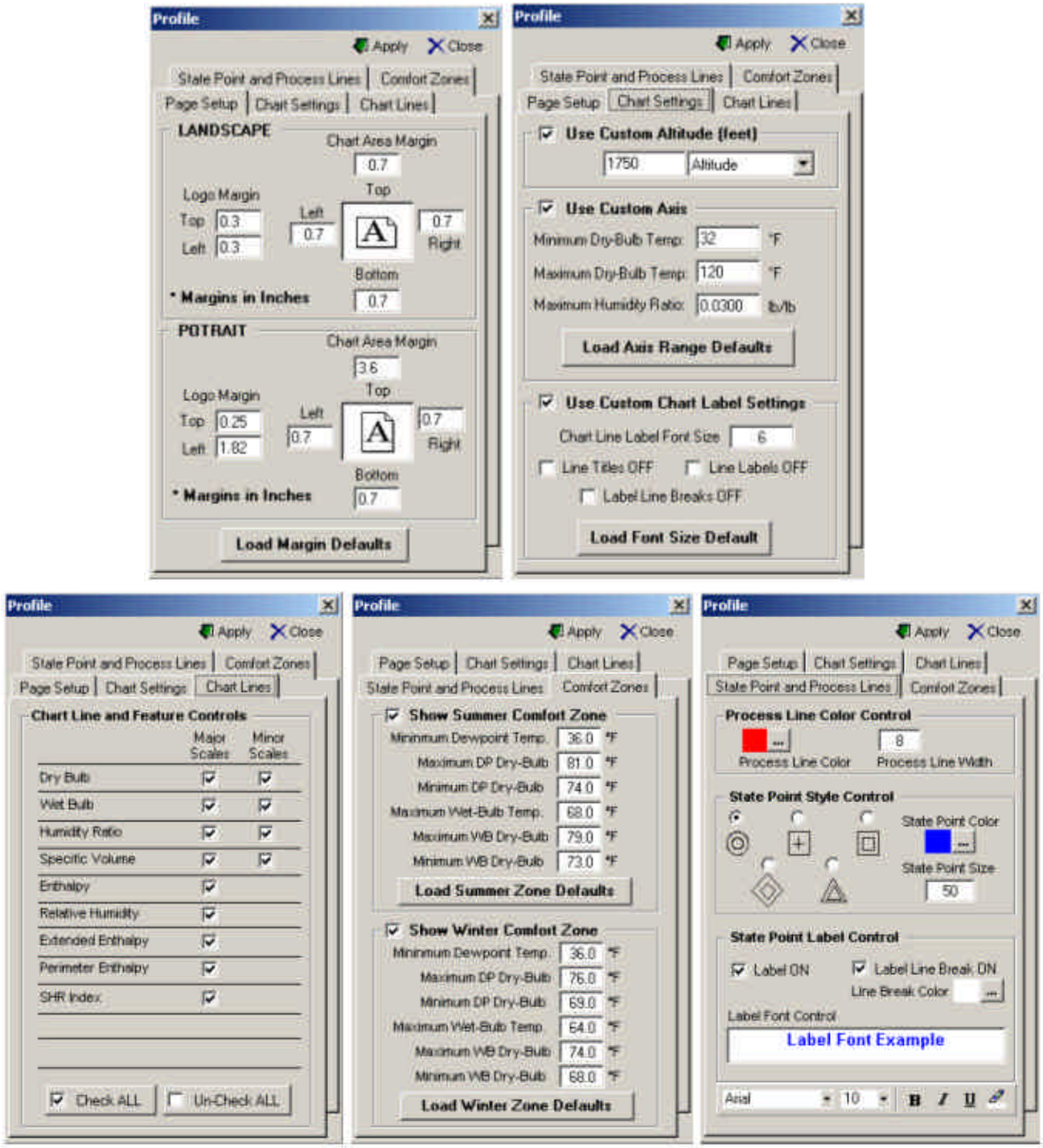
Complete project information and note capabilities!! Notes are individually controlled allowing for font, color, border, background, etc to all be specific to each note. Complete Drag-n-drop functionality as well as new-edit-delete note management!!



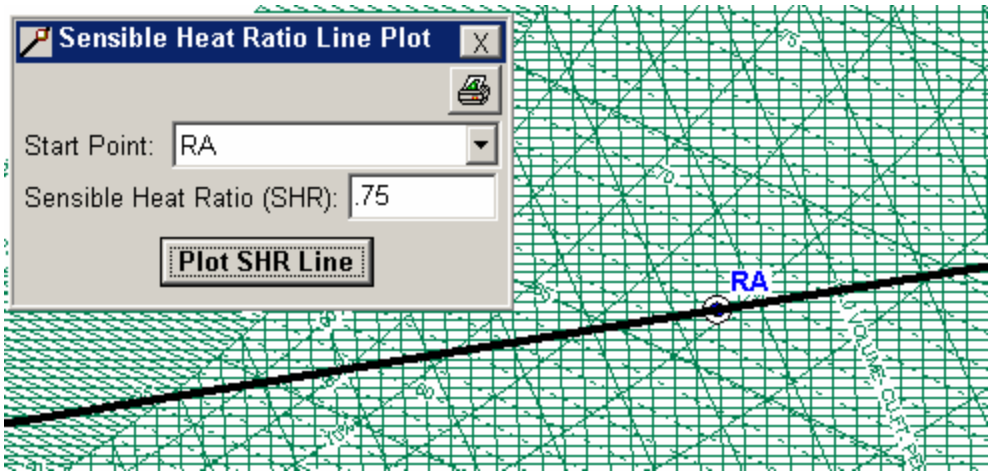
User information and auto note display capability!! User information is added only once and is automatically available for displaying on both the chart and/or the state point and process report!!



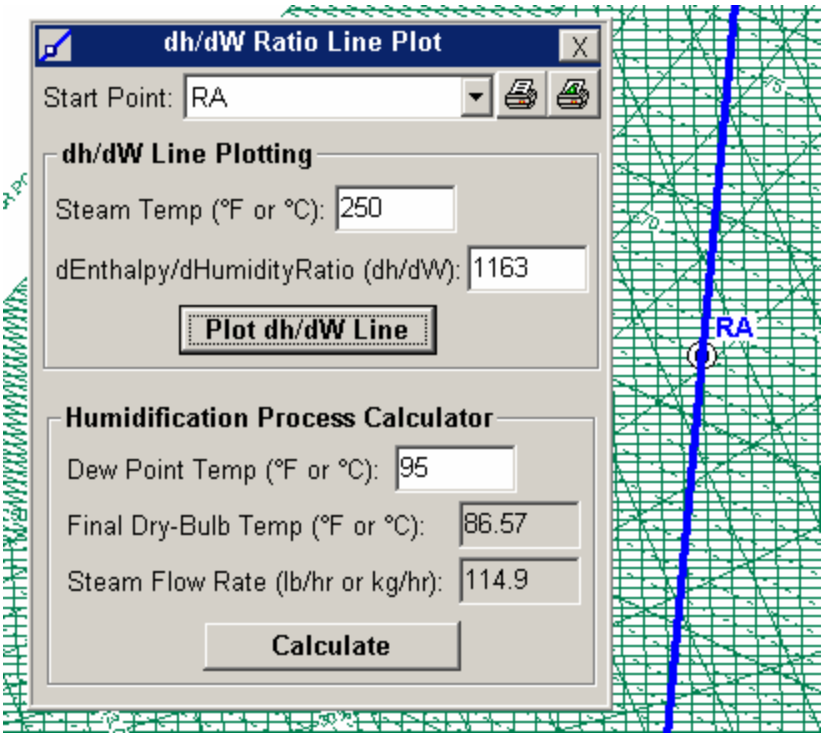
Complete Chart control including virtually any Altitude or Pressure, Dry-Bulb and Humidity Ratio Axis Limit Control, turning Lines ON & OFF, Process line color and width, state point icon and size, state point label font control, Comfort Zones, Page Setup and more!!



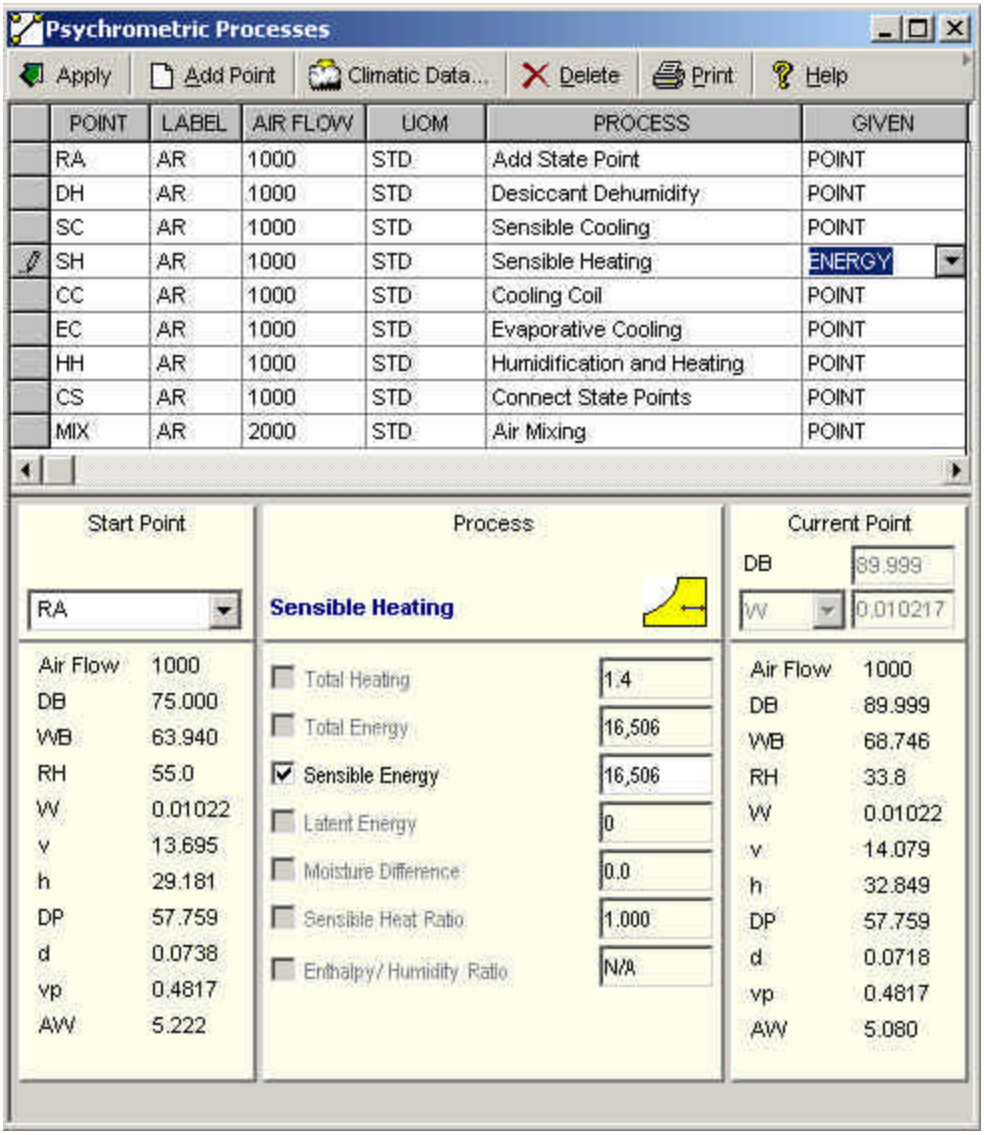
Sensible Heat Ratio Line Plotting is available with one simple button click!! Type the desired SHR and click the button and instantly, the requested SHR line is displayed on the chart!!



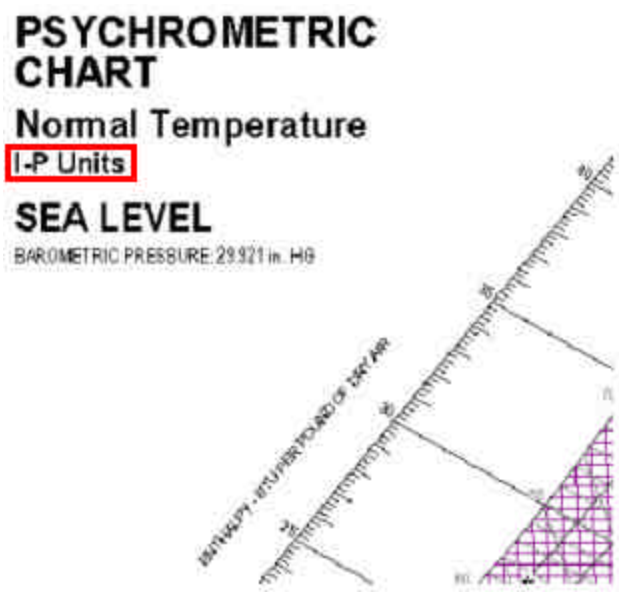
Humidification Delta-Enthalpy / Delta-Humidity Ratio Line Plotting is available with one simple button click!! Steam Flow rate is automatically calculated based on desired Final Dew Point Temperature!!

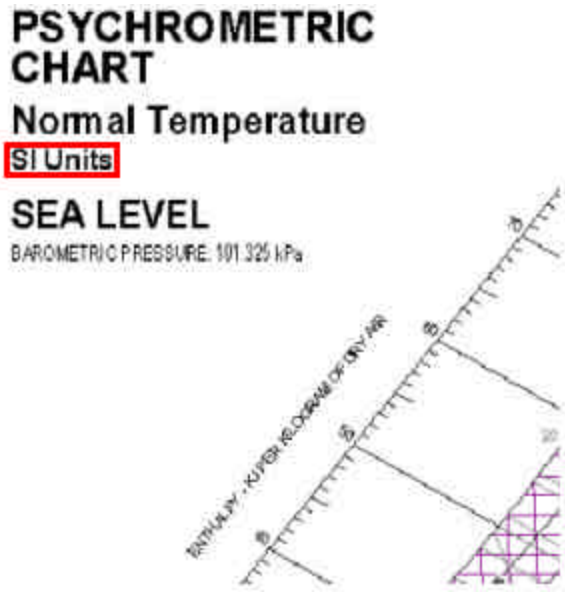


Complete State-Point and System Process Analysis capable. Process modeling includes AIR MIXING, COOLING COIL, EVAPORATIVE COOLING, DESICCANT DEHUMIDIFICATION, HUMIDIFICATION and SENSIBLE HEATING & COOLING!! All processes can either have END POINT specified, CALCULATING PROCESS DATA or PROCESS DATA specified, CALCULATING END POINT result!


Psychrometric Processes
Apply
Add Point
Climatic Data...
Delete
Print
Help
POINT | LABEL | AIR FLOW | UOM | PROCESS | GIVEN
RA | AR | 1000 | STD | Add State Point | POINT
DH | AR | 1000 | STD | Desiccant Dehumidify | POINT
SC | AR | 1000 | STD | Sensible Cooling | POINT
SH | AR | 1000 | STD | Sensible Heating | ENERGY
CC | AR | 1000 | STD | Cooling Coil | POINT
EC | AR | 1000 | STD | Evaporative Cooling | POINT
HH | AR | 1000 | STD | Humidification and Heating | POINT
CS | AR | 1000 | STD | Connect State Points | POINT
MIX | AR | 2000 | STD | Air Mixing | POINT
Start Point
RA
Air Flow 1000
DB 75.000
WB 63.940
RH 55.0
W 0.01022
v 13.695
h 29.181
DP 57.759
d 0.0738
vp 0.4817
AW 5.222
Process
Sensible Heating
Total Heating 1.4
Total Energy 16,506
Sensible Energy 16,506
Latent Energy 0
Moisture Difference 0.0
Sensible Heat Ratio 1.000
Enthalpy/ Humidity Ratio N/A
Current Point
DB 89.999
W 0.010217
Air Flow 1000
DB 89.999
WB 68.746
RH 33.8
W 0.01022
v 14.079
h 32.849
DP 57.759
d 0.0718
vp 0.4817
AW 5.080

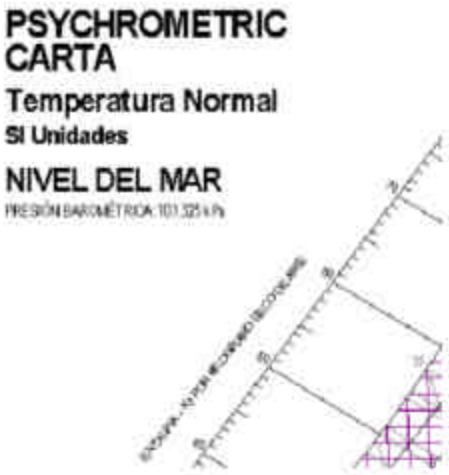
All Charts, state-points and process data are converted automatically between **IP and/or SI** with the click of a button!!



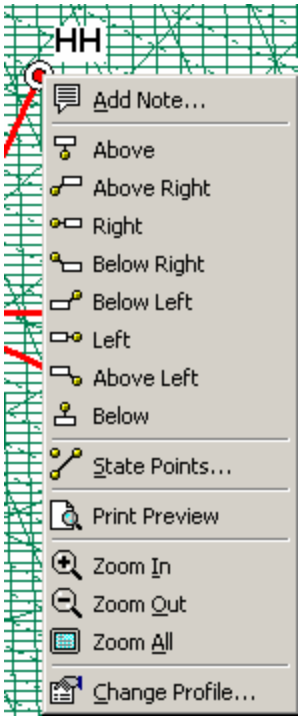


Ability to export chart and reports out in PDF format automatically!!

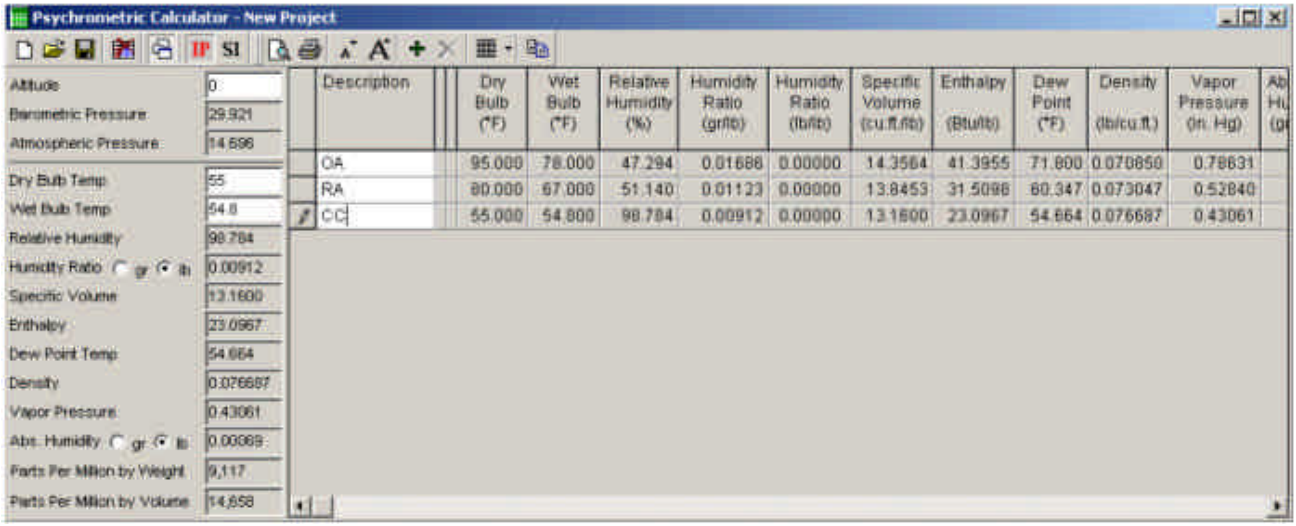
Automatically convert between **(10) different Languages** just by Clicking a button!!



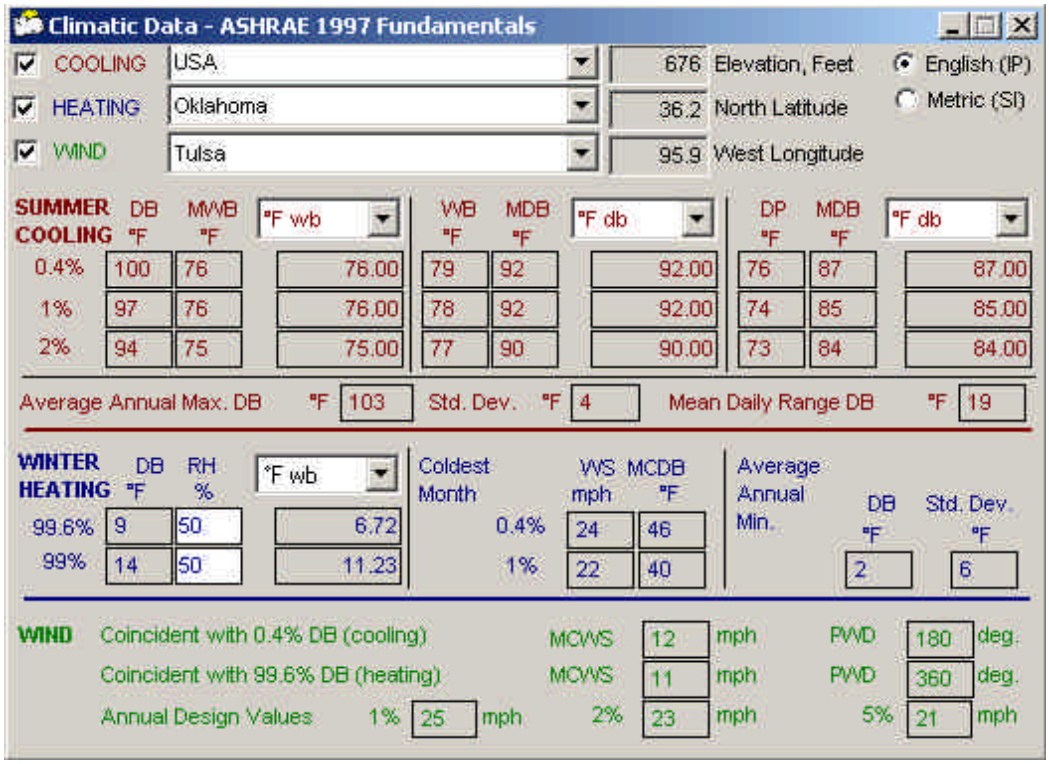
Right-Click Pop-Up menus allow for easy control of the chart whether it's moving state-point labels or managing chart notes!! Left Double-Click automatically ZOOMS-IN and Right Double-Click automatically ZOOMS-OUT. Hold the left buttom down and Drag allows you FULL PANNING of the chart!!



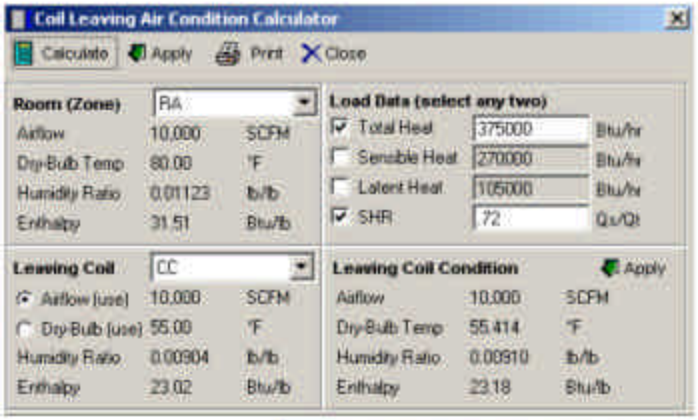
Complete Psychrometric Calculator with File-Open-Save capabilities and outputs in either IP or SI units!!

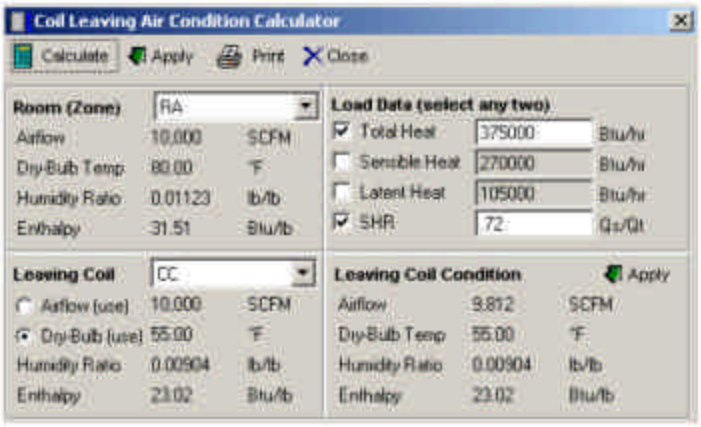


Complete Climatic Outside Air Design Data for over 1,000 cities throughout the WORLD for **either IP or SI units**!!

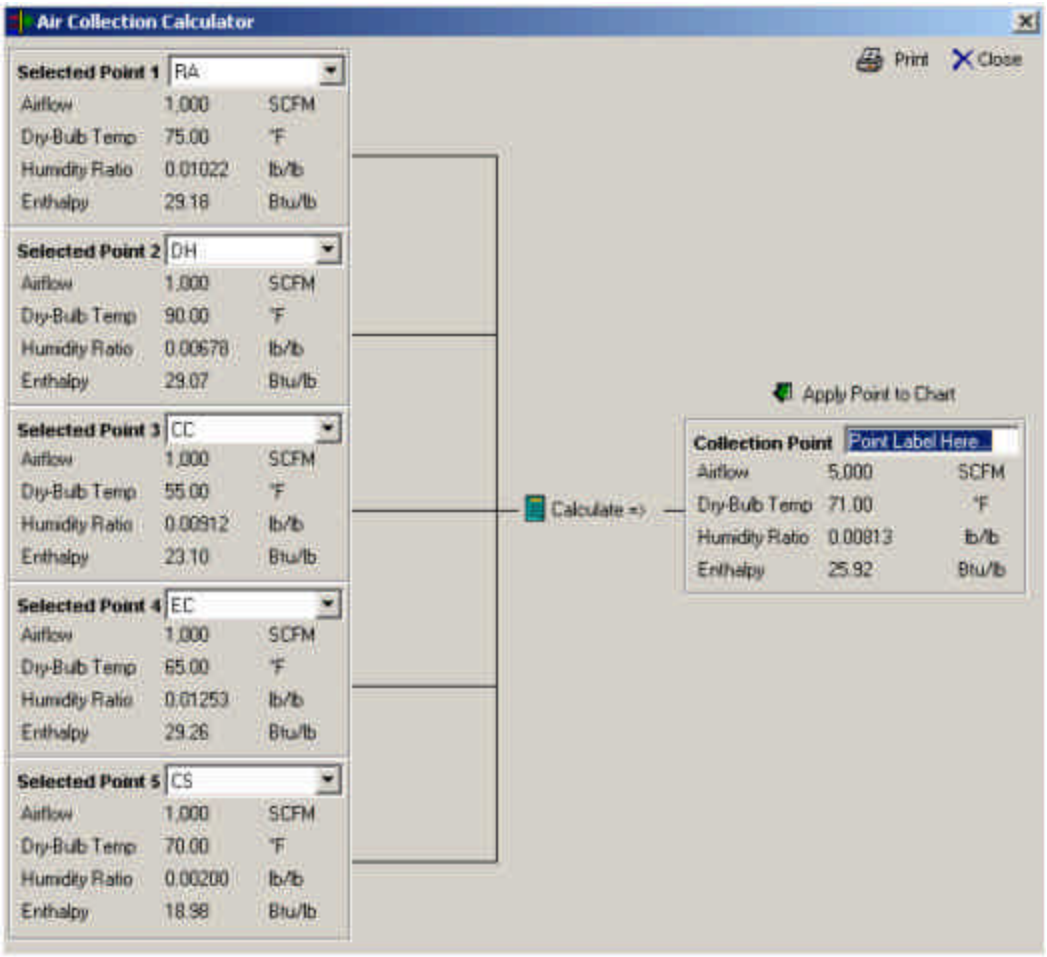


Complete Cooling Coil Leaving air condition calculator!!! Automatically calculate the Leaving air temperature or the airflow for cooling coils!!

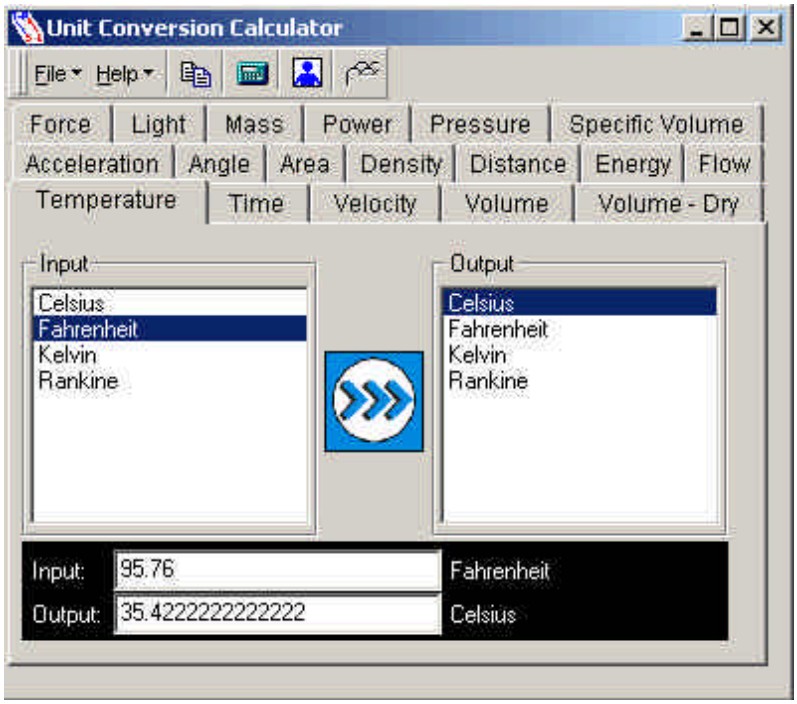




Integral Air Collection Calculator!! Simply click on the combo box drop downs and select the state points desired for collection, and with one “Calculate =>’ button click, your system collection point is automatically displayed, available to be added to your system, chart and report!!

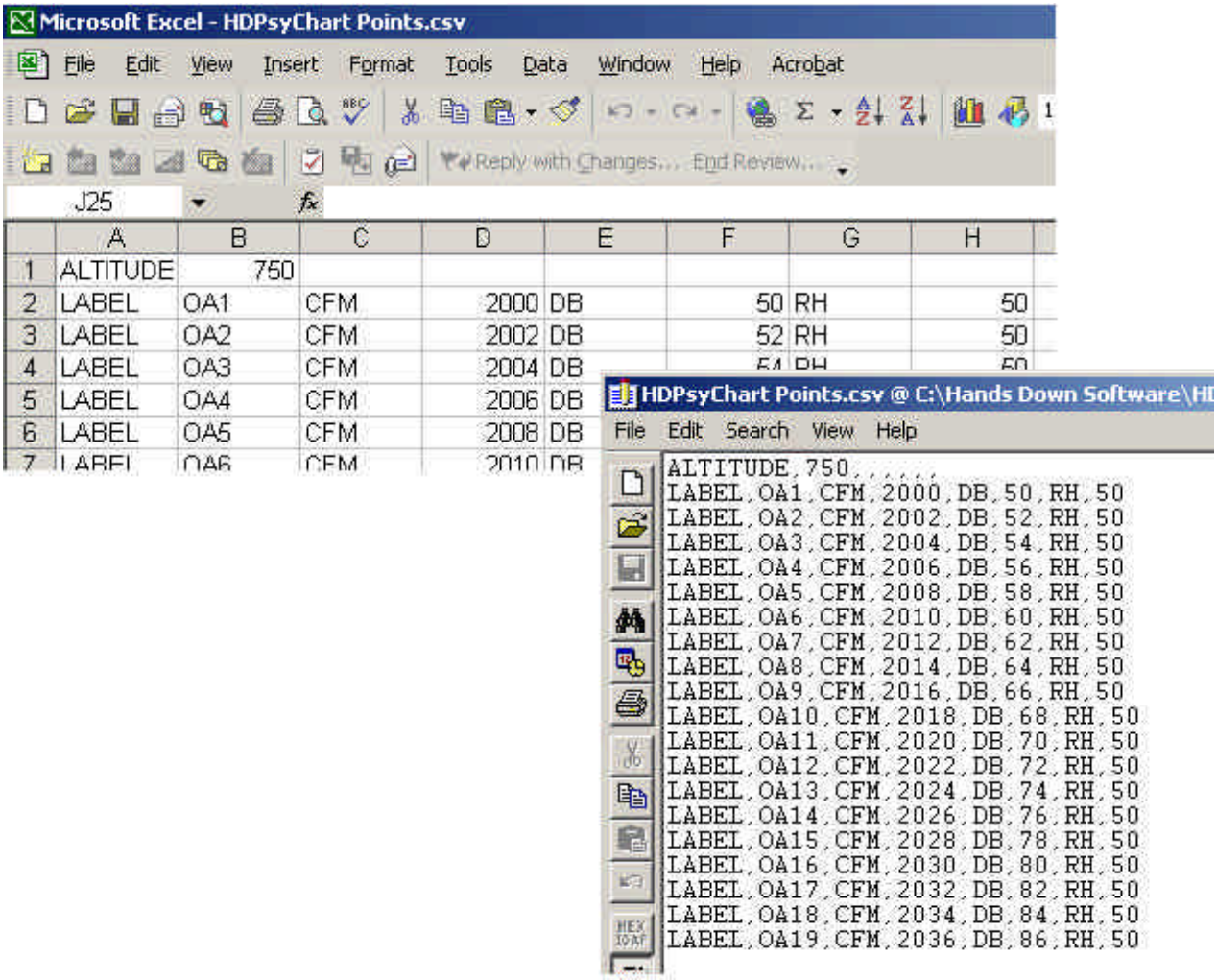


Complete unit of conversion calculator for quick and easy IP<>SI unit conversions!!

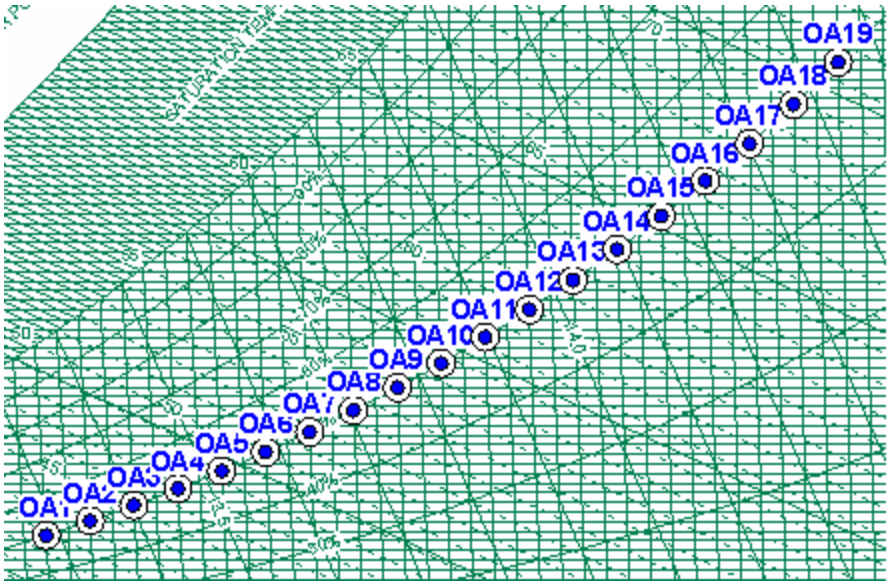


Complete Data Exchange Capabilities!! You can export data, charts and reports either by Edit-Copy copying to the clip board, or by automatically exporting out to a PDF file!!

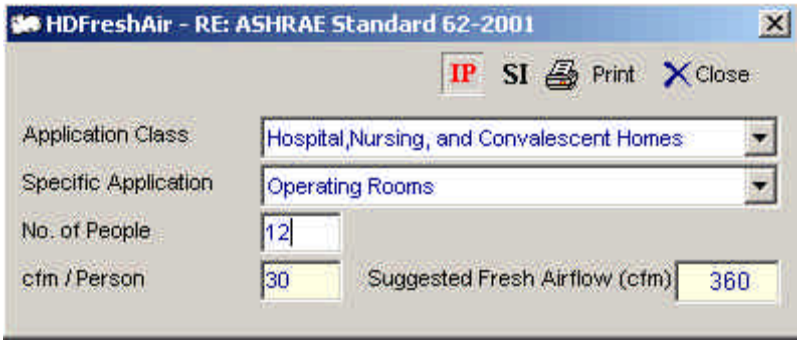
Importing of Data is accomplished with comma delimited ".csv" files which can easily be generated with any text editor or spreadsheet program such as Microsoft Excel!!!



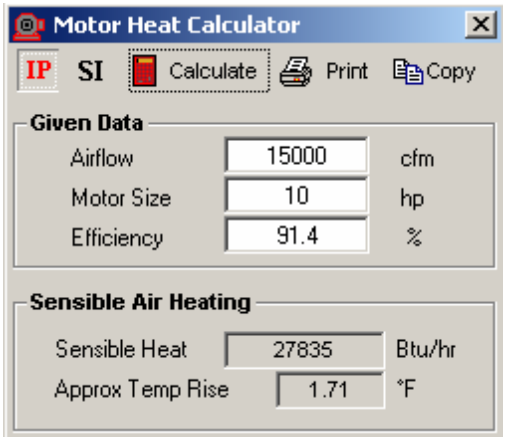
	A	B	C	D	E	F	G	H
1	ALTITUDE	750						
2	LABEL	OA1	CFM	2000	DB	50	RH	50
3	LABEL	OA2	CFM	2002	DB	52	RH	50
4	LABEL	OA3	CFM	2004	DB			
5	LABEL	OA4	CFM	2006	DB			
6	LABEL	OA5	CFM	2008	DB			
7	LABEL	OA6	CFM	2010	DB			



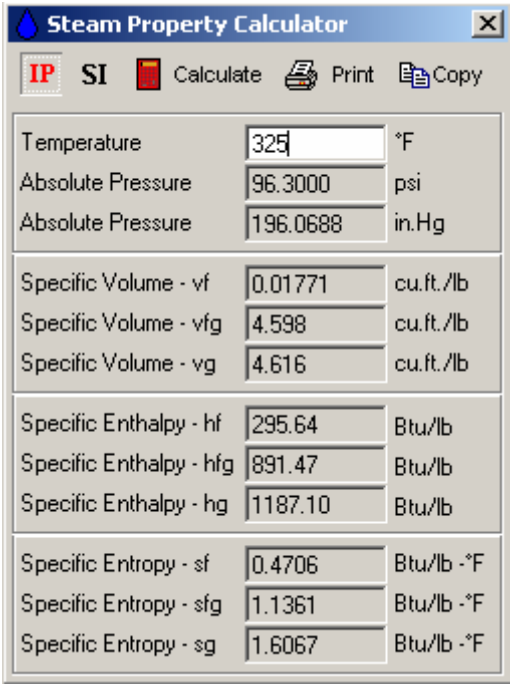
Fresh Air estimator providing outdoor air requirement estimates referencing ASHRAE Standard 62-2001 in **both IP and SI units!!**



Motor heat calculation is one button click away!! Simply type in the motor size (power) and the efficiency and instantly get the resulting sensible heat generated by the motor along with the corresponding temperature rise!!



Complete Steam Property Calculator in both IP and SI units of measure!!!



TECHNICAL SUPPORT

Technical support is free of charge and available by fax, mail, email and through our World Wide Web site.

It is our policy to respond to all inquires within 48 hours from receipt.

Please include Version number found in the “About” box under the Help menu with your inquiry.

Email: support@handsdownsoftware.com

Phone: 405.844.6314

Fax: 405.844.6314

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CONTACT US

HANDS DOWN SOFTWARE

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Email: info@handsdownsoftware.com

OFFICE HOURS

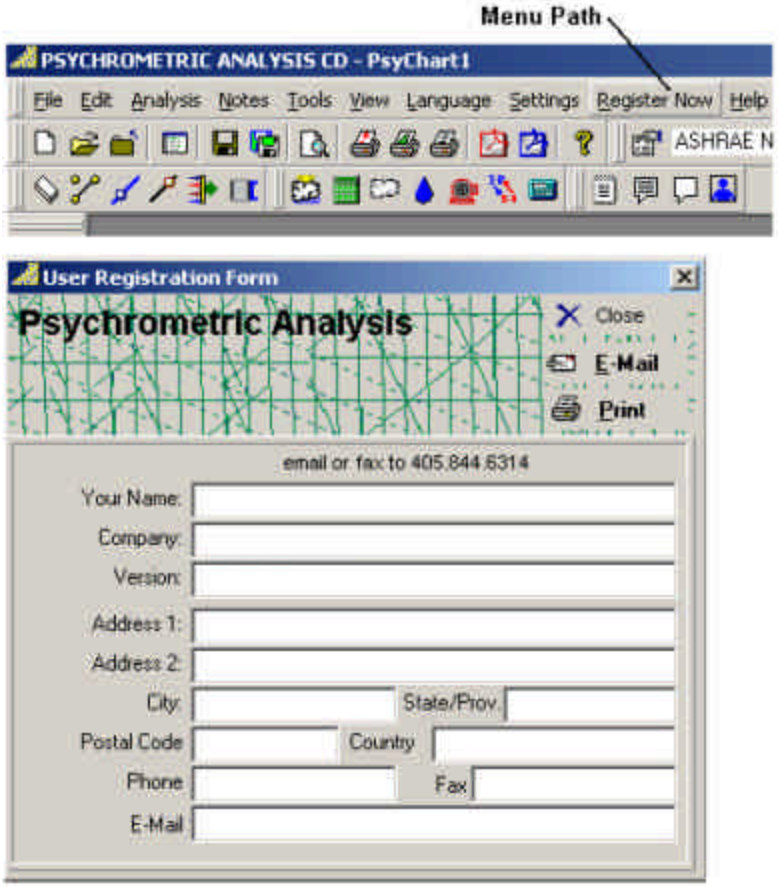
8:00 am - 5:00 pm Central Standard Time
Monday through Friday

HOLIDAYS

New Year's Day
Memorial Day
July 4th
Labor Day
Thanksgiving
Christmas

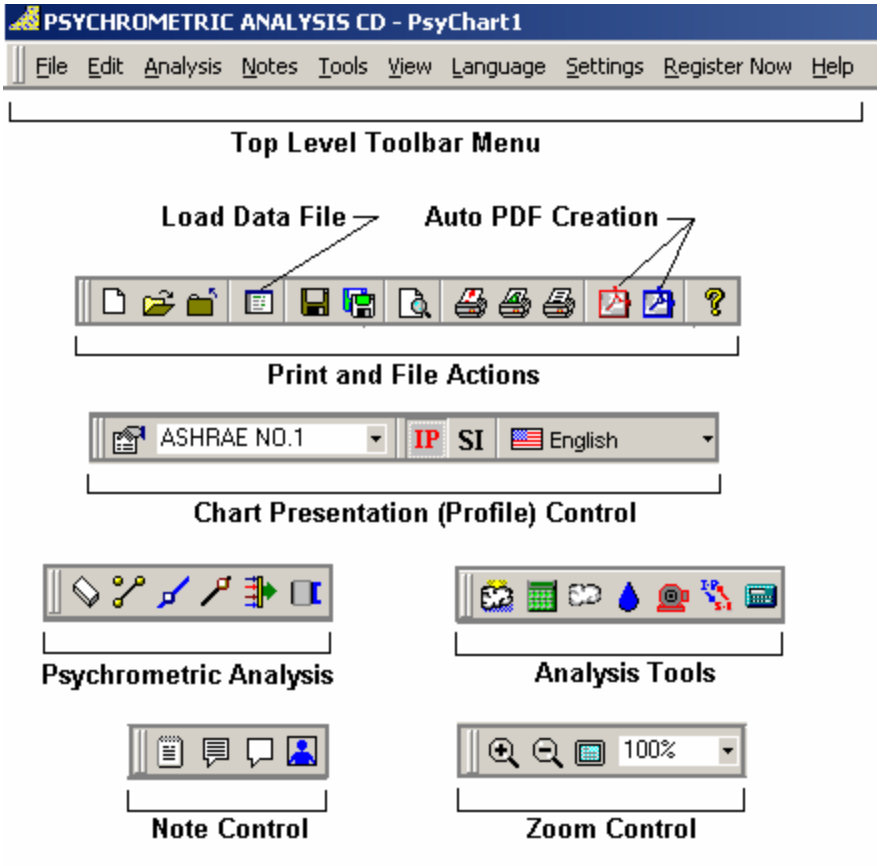
REGISTRATION

When you register as a User of this program, your contact information is included in email notification broadcasts of Corrective Patches, New Features, New Versions, Tips, etc., everything you need to stay current.



MENUS AND TOOLBARS

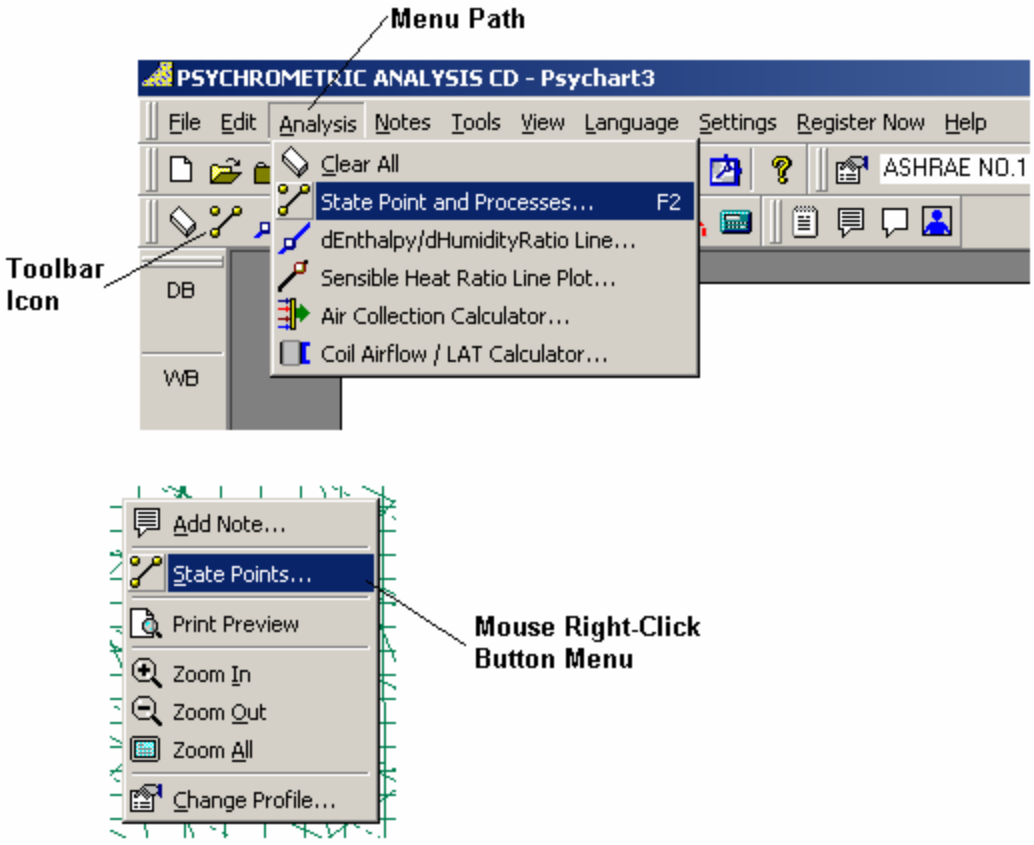
You can access the Psychrometric Analysis services via a standard Windows menu and tool bar system. Each component of the system can be dragged and docked to the top, bottom, left or right sides of the Psychrometric Chart Window, or can become floating menus positioned anywhere within the Psychrometric Window.



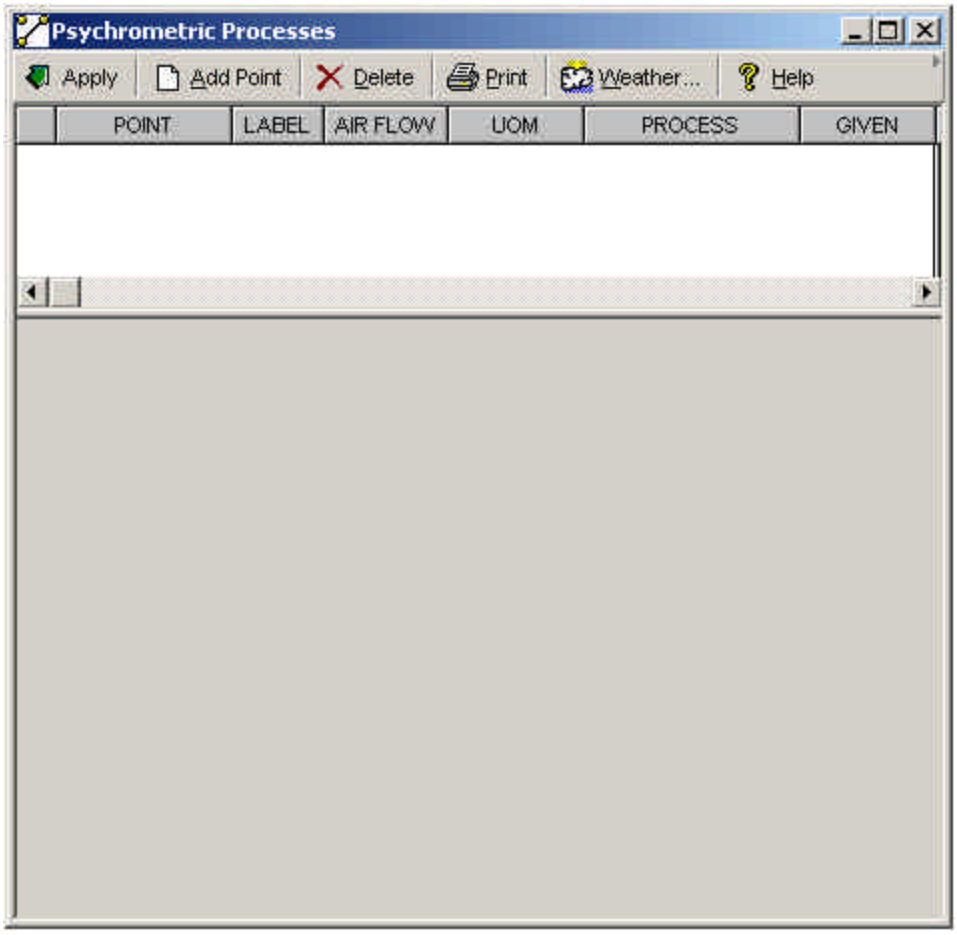
In addition to accessing these services, a constant display of the mouse position in psychrometric property terms is available at all times. The values are displayed in a button bar that can be docked or floating just as the Psychrometric Analysis's other button bars. See the graphic to the left. Let the mouse pointer hover over a value for just a couple of seconds and the engineering units for that value are displayed. The values can be configured for your own needs via the button bar customize option as described above.

STATE POINT & PROCESS PLOTTING

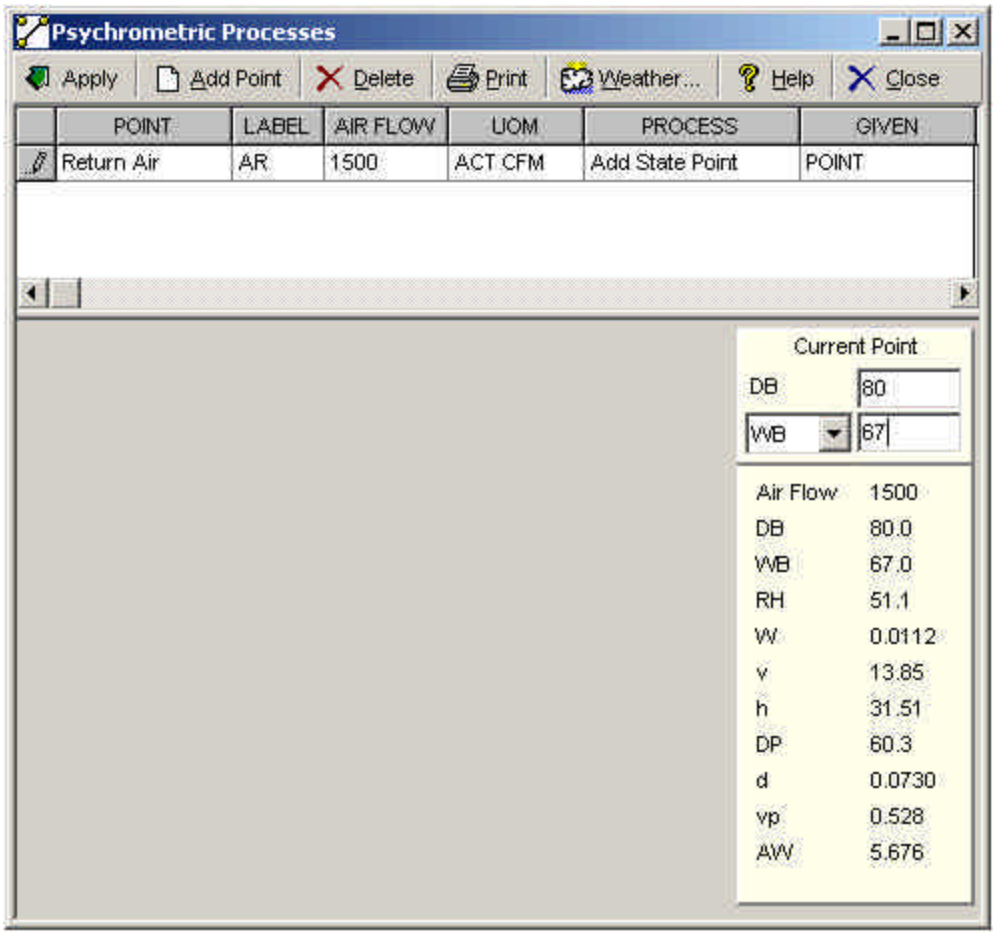
1. Activate "State Point and Processes" by any of the three methods shown below:



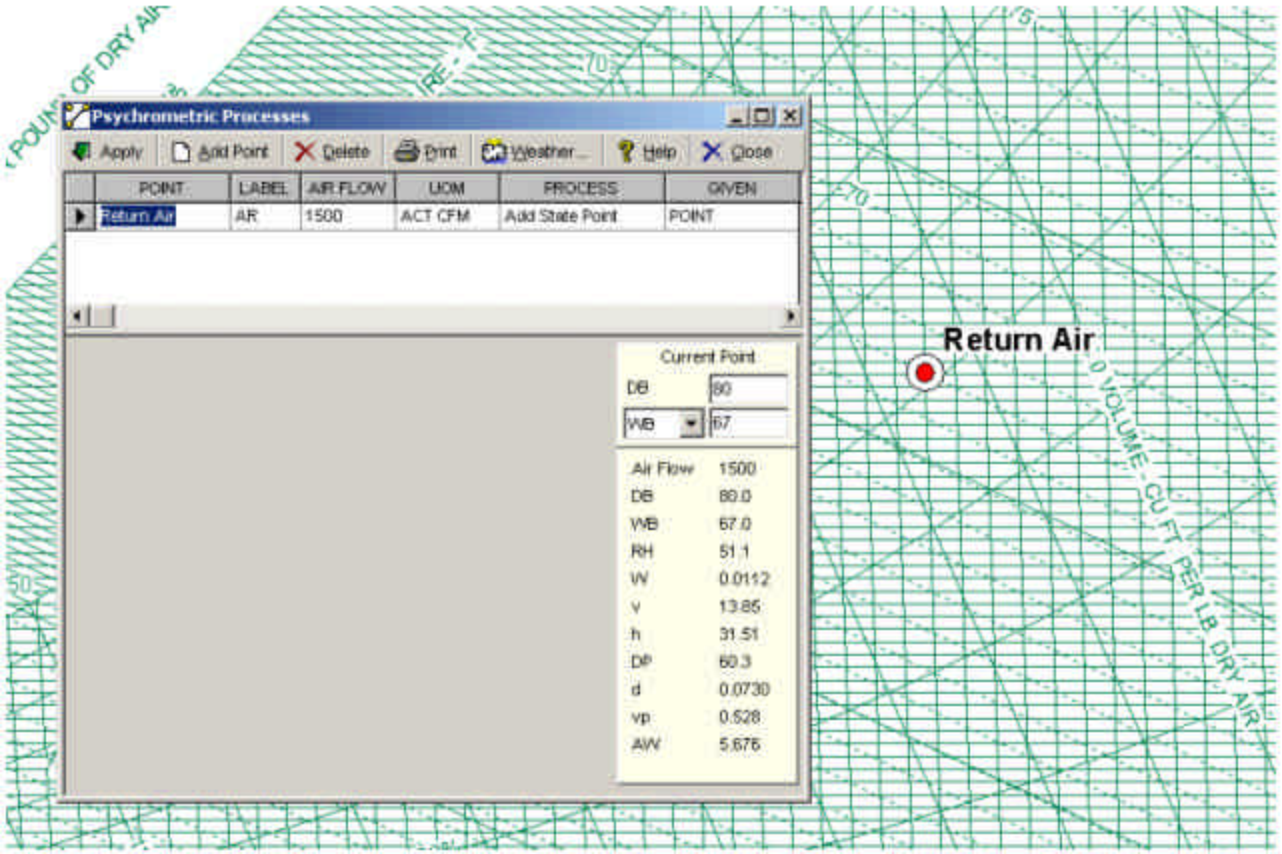
2. The Psychrometric Processes window appears with blank data fields.



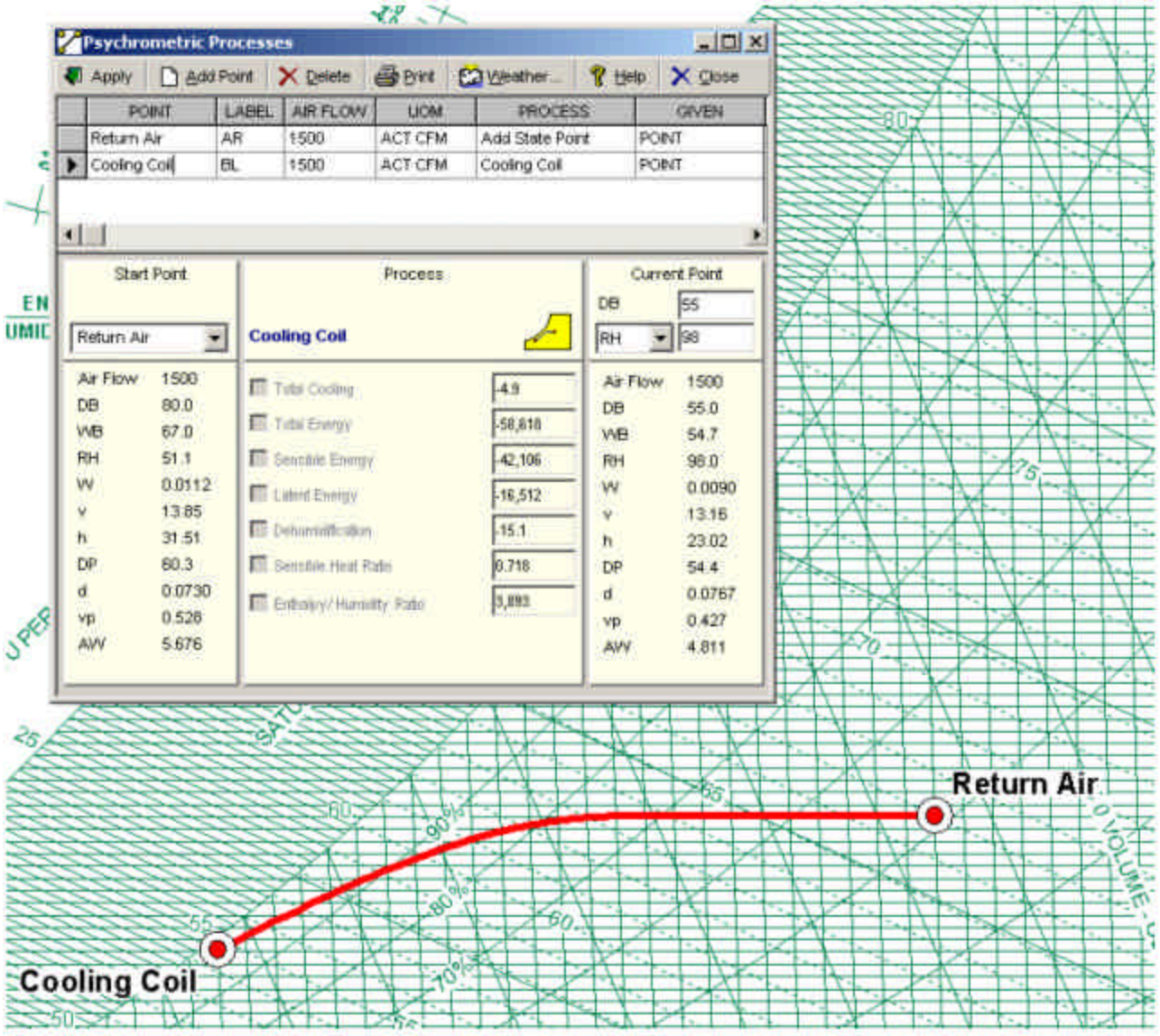
3. To enter a new point, click the Add Point button. Fill in the grid information as needed (point name, point label location, enter the airflow, select air flow units, select process and select given option). If this is the first point, the only process offered is "Add State Point" since there are no other points to create a process with. Click on the "Current Point" panel and enter dry bulb temperature, enter moisture value and select moisture property from the drop-down box.



4. Click on the Apply button and the point is plotted to the chart.

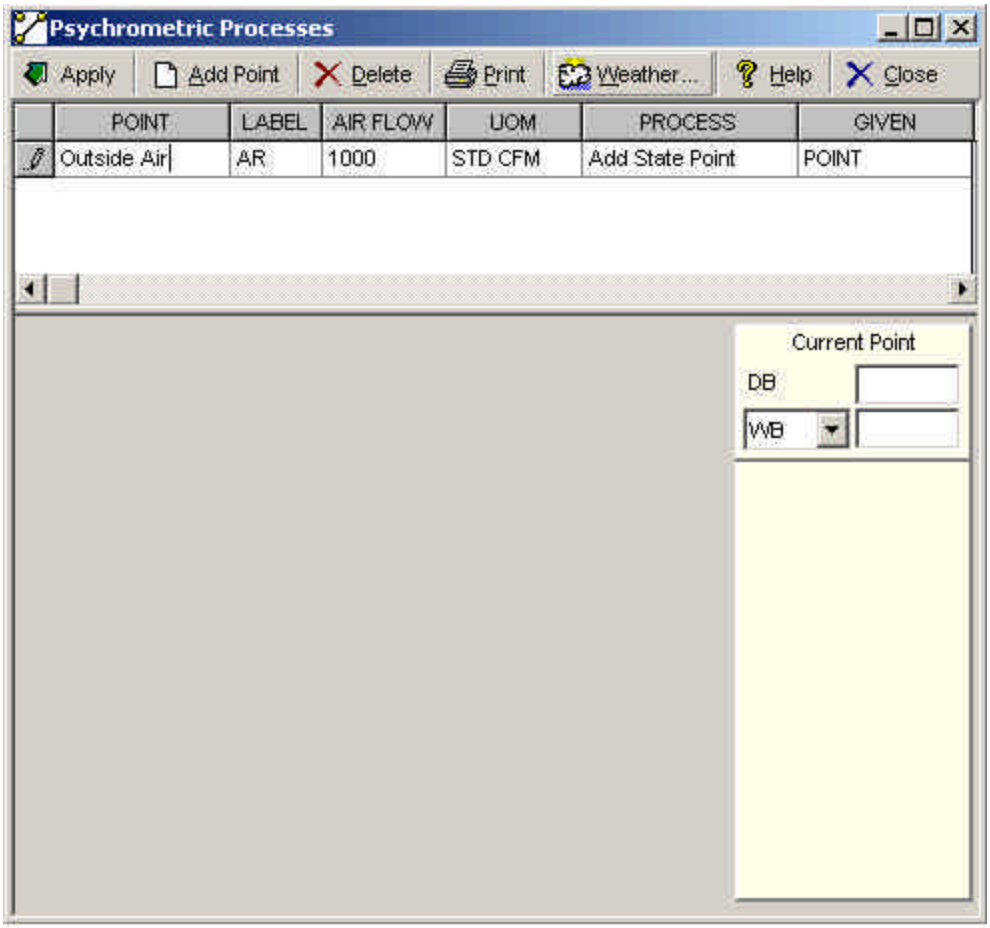


5. Click the Add Point button again to continue adding new points. Adding more than one point enables additional PROCESSES to be selected in the grid. The GIVEN column will also be enabled, after the first point is entered, to allow entering either the end point (POINT), calculating the process energy or entering the process energy (ENERGY) and calculating the end point. After each successive point, click the Apply button to plot the point and process to the chart.

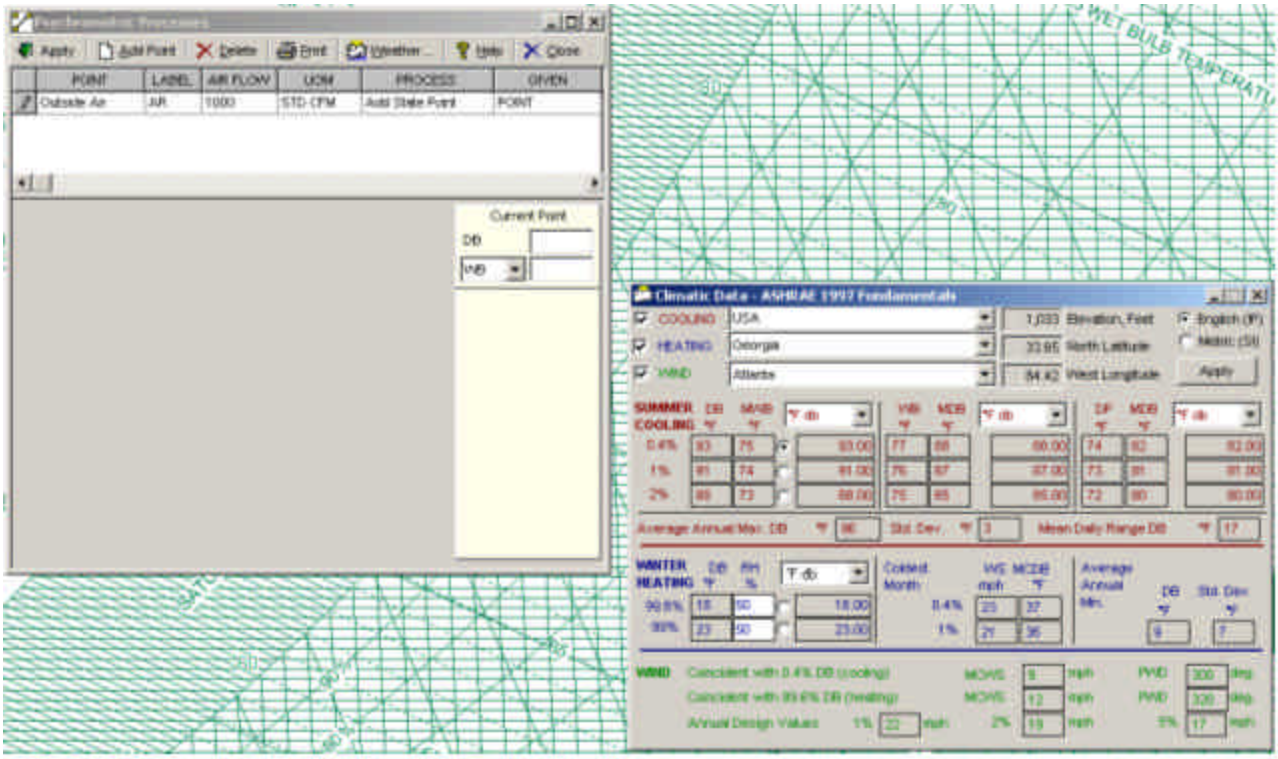


Additional processes can be added to complete any system. If you need to make changes you may do so to any point by just clicking on the proper grid row, make any desired changes and simply click "Apply" and the point and connecting processes are automatically updated.

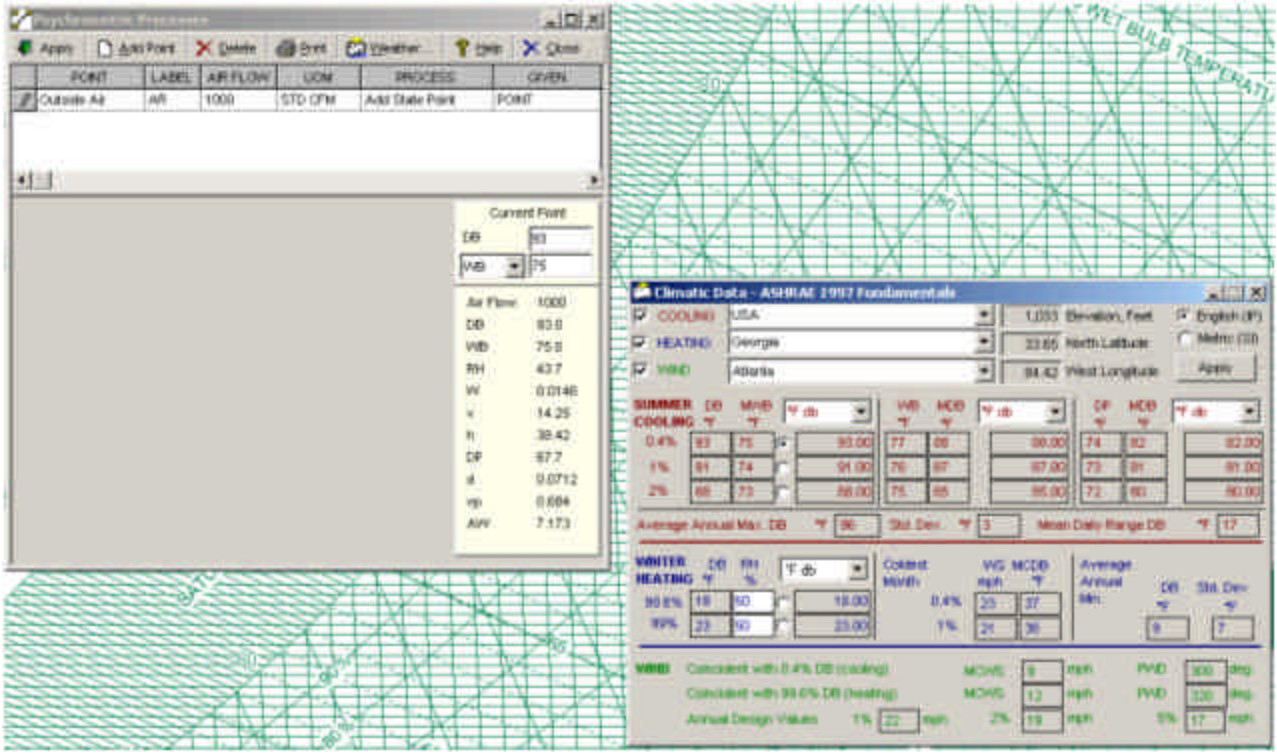
6. To apply a Climatic Data weather point to the chart, simply click on the Weather icon to access the Climatic Data Window.



7. Select the geographic location by country, state and city. Select the desired outside design condition (for Summer Cooling: 0.4%, 1% or 2%) (for Winter Heating: 99.6% or 99%).



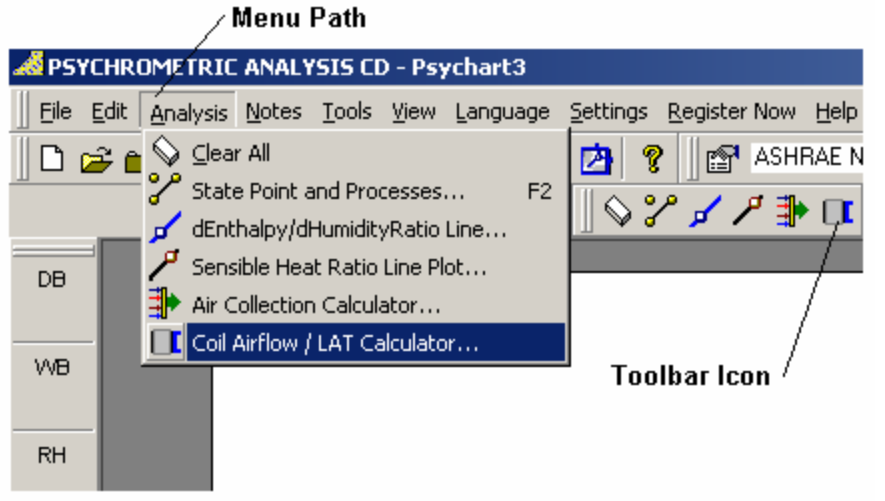
8. To apply this design condition as a State Point, simply click the Apply button in the upper left hand of the Window and then close the Climatic Data Window to return to State Points & Processes.



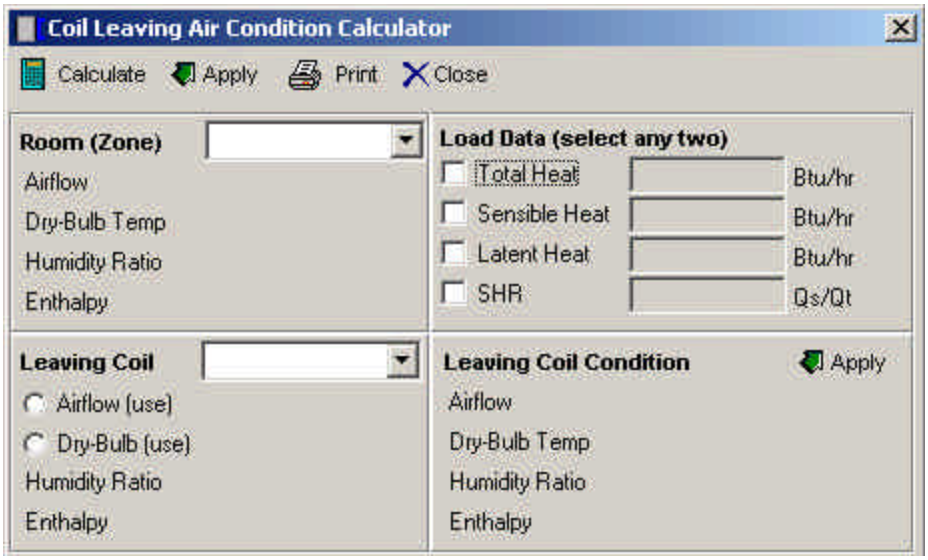
COIL LEAVING AIR CALCULATOR

1. NOTE: You need to have the Zone state point and Coil state point created for reference by the Coil Airflow/LAT Calculator BEFORE continuing.

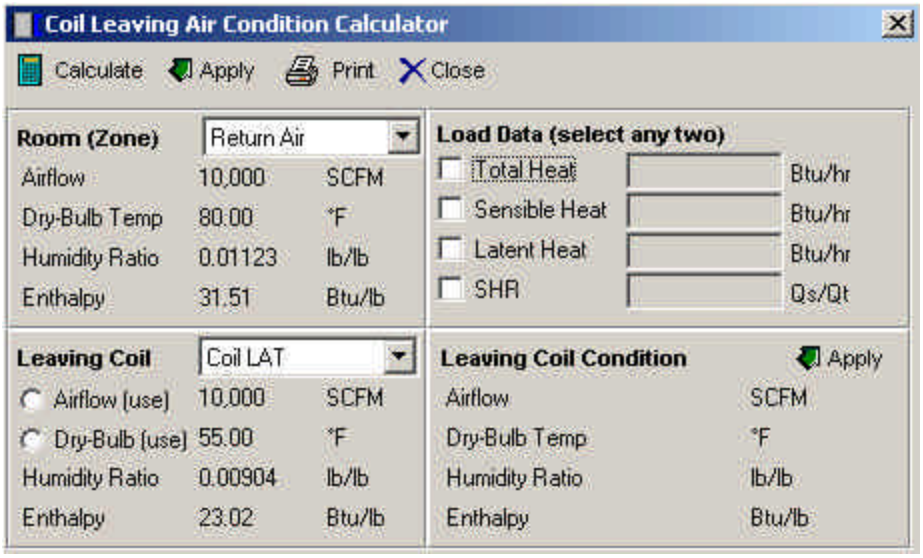
2. Activate "Coil Airflow / LAT Calculator" by either of the two methods shown below:



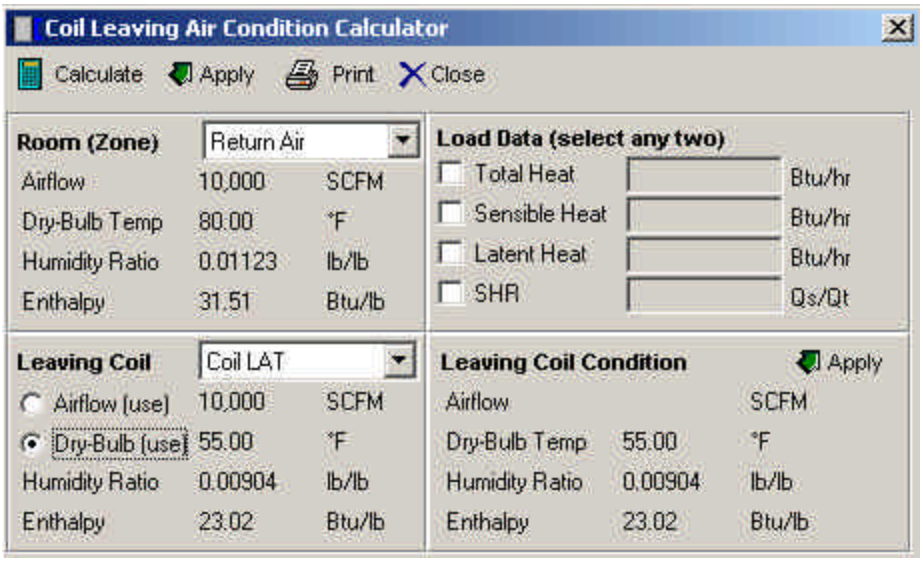
3. The Coil Airflow / LAT Calculator window appears with blank data fields.



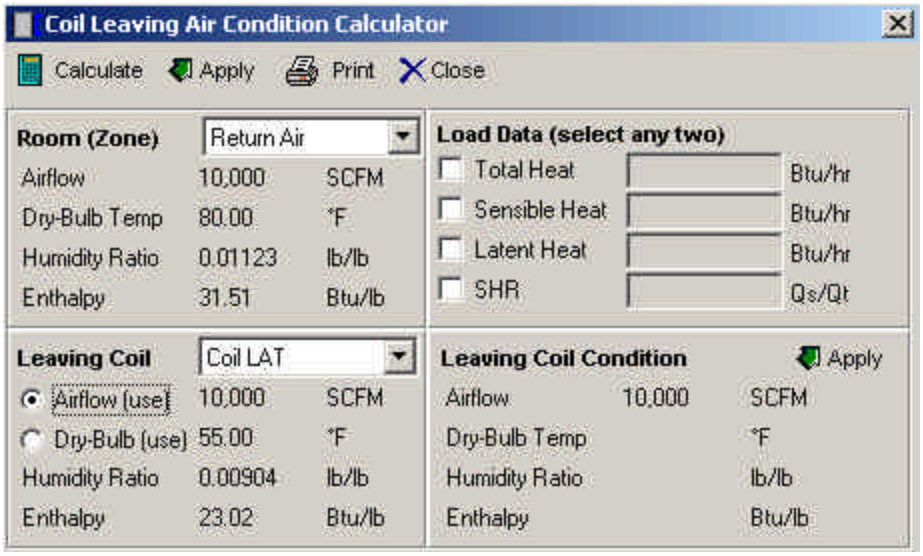
4. Click the Room (Zone) and Coil combo box drop-downs and select the desired points that you've already created with the State Point and Process dialog.



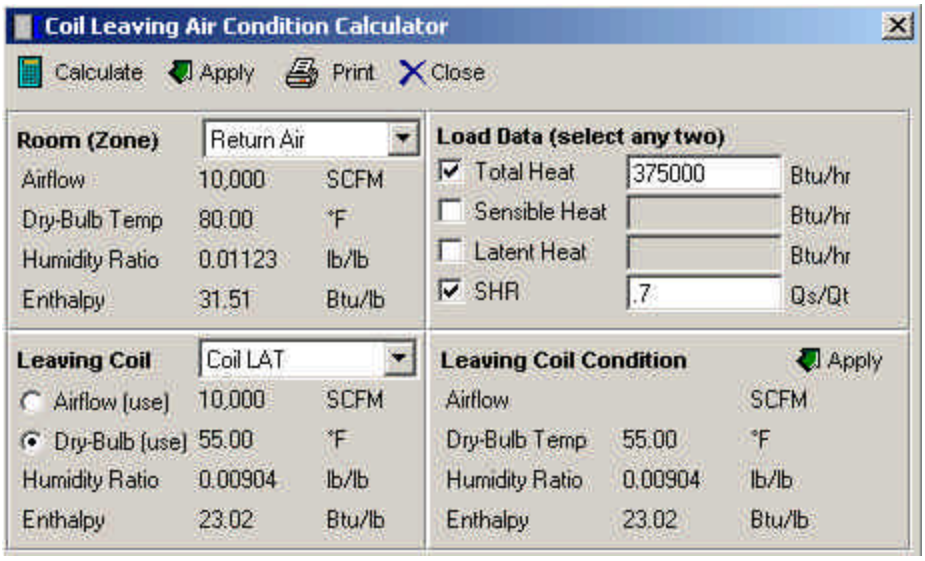
5. To calculate coil leaving airflow, click the "Dry-Bulb (use)" option.



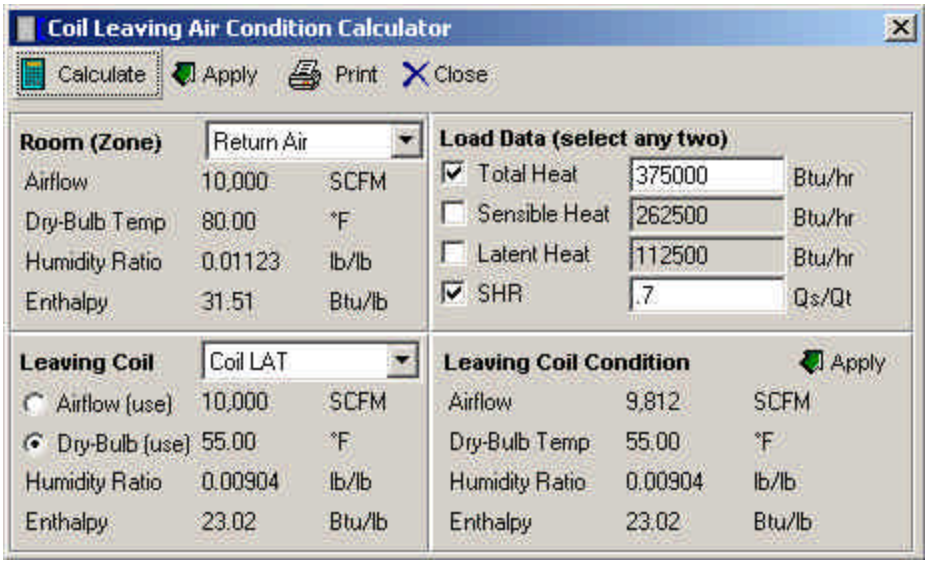
6. To calculate coil leaving dry-bulb, click the “Airflow (use)” option.



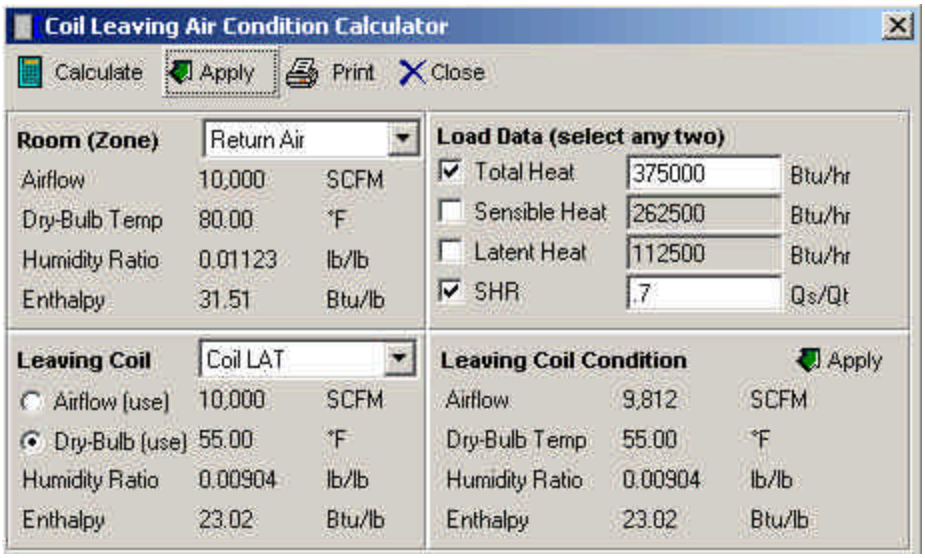
7. Click any two of the Load Data variables you wish to specify and input the appropriate values.



8. Lastly, click “Calculate” to see the results.



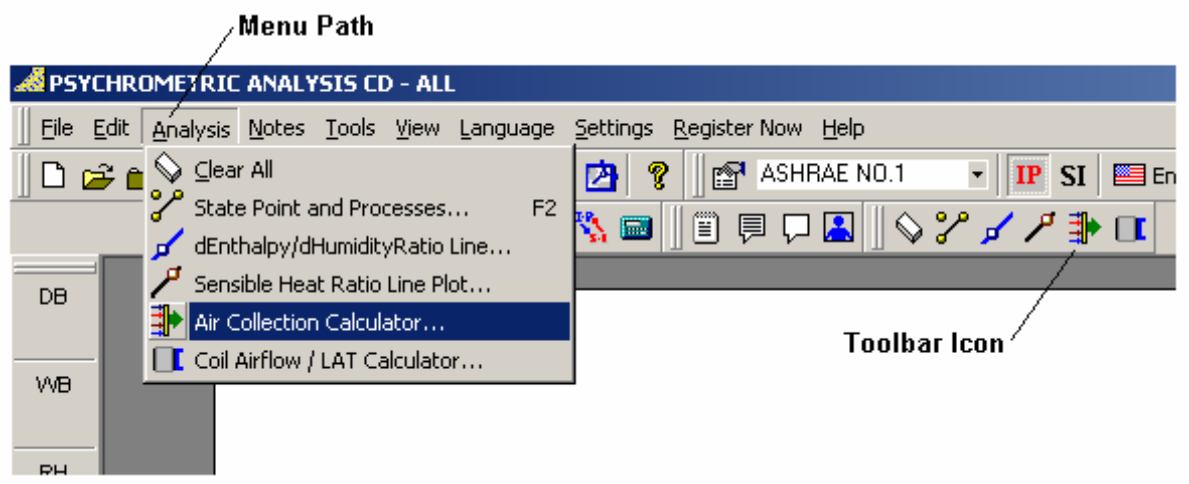
9. To Update the Coil LAT point created with the calculated result, simply click “Apply” on the menu and the point and chart are automatically updated.



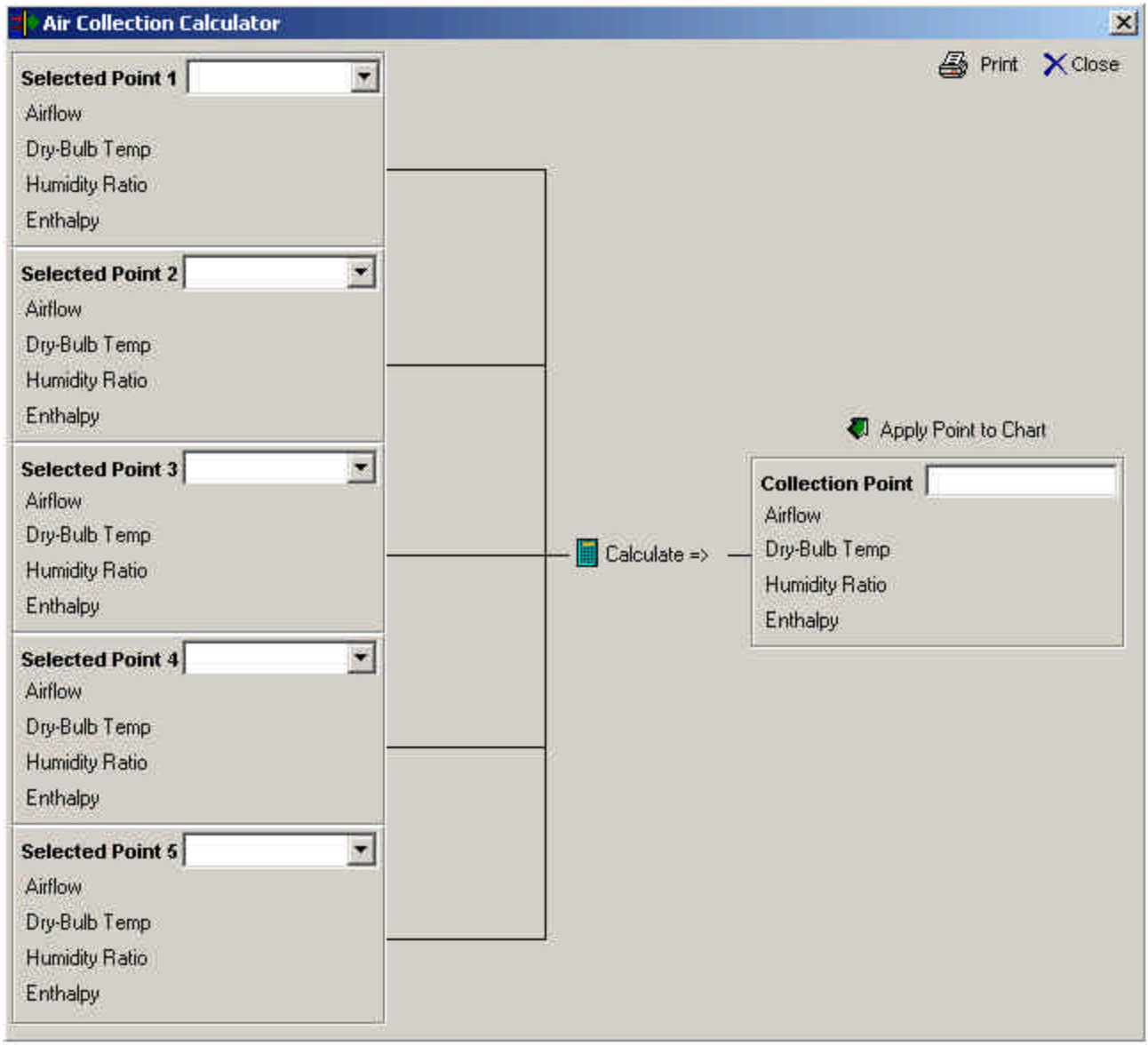
AIR COLLECTION CALCULATOR

1. NOTE: You need to have two or more points created BEFORE calculation of a collection point can be performed.

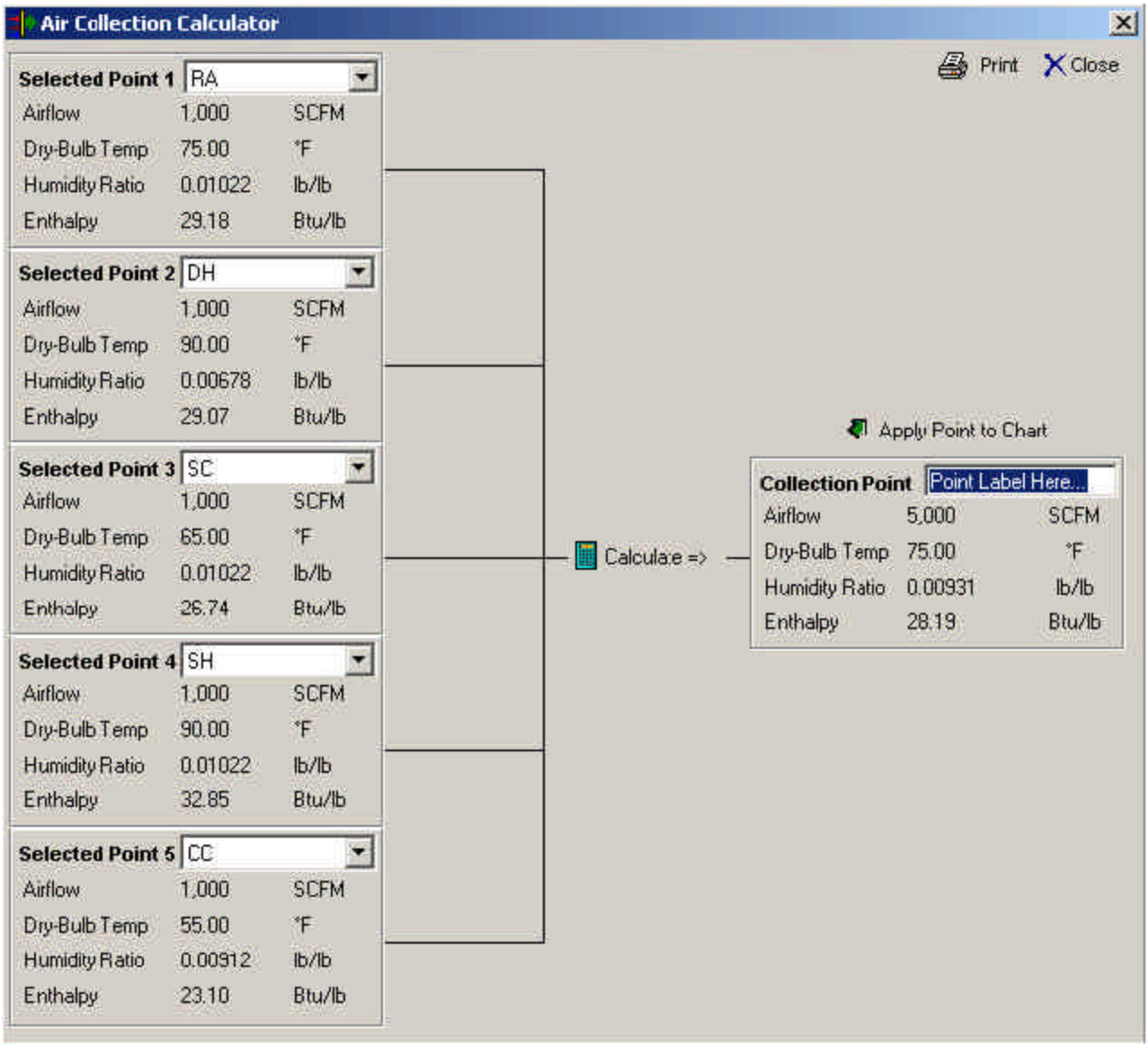
2. Activate "Air Collection Calculator" by either of the two methods shown below:



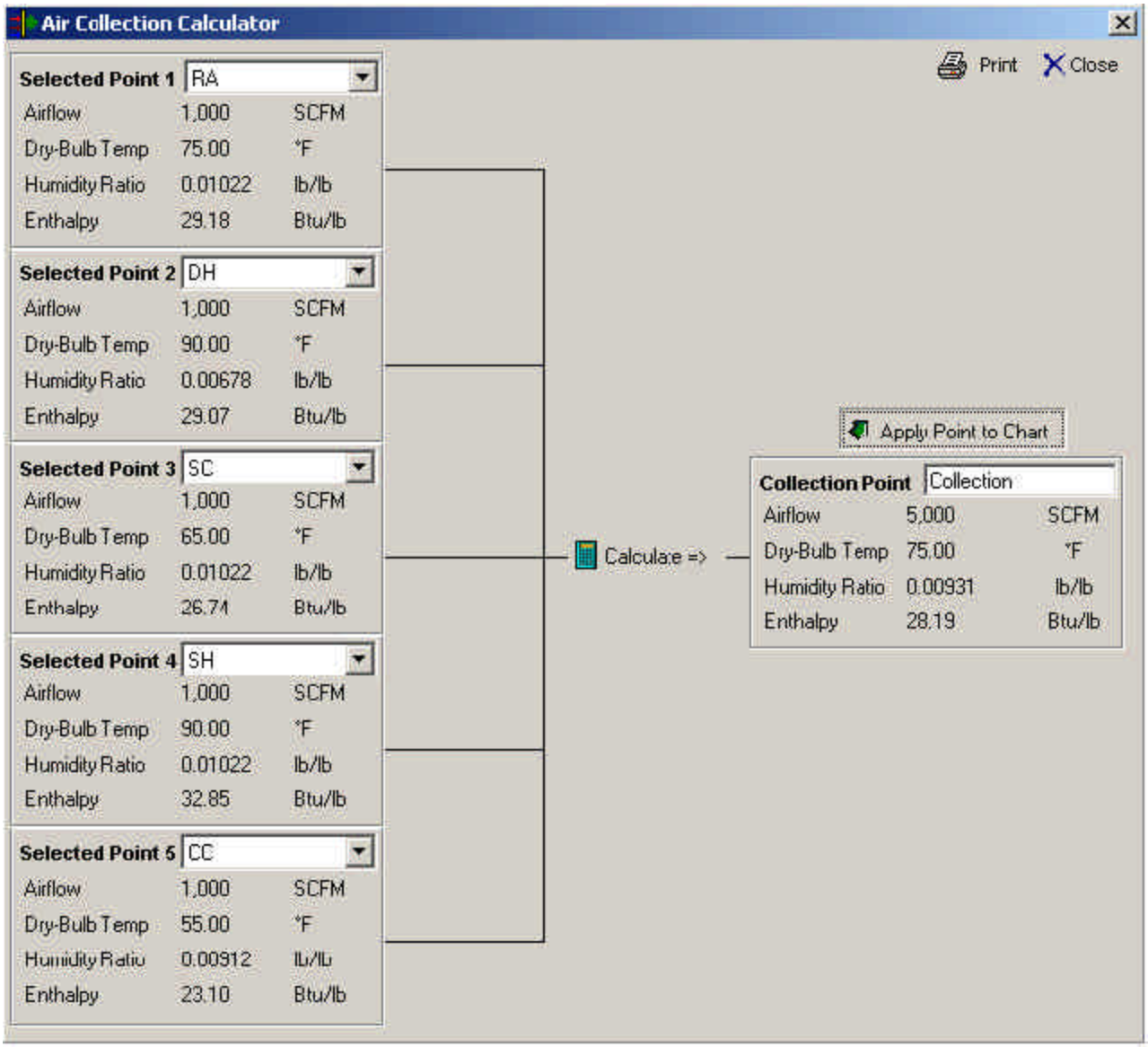
3. The Air Collection Calculator window appears with blank data fields.



4. Click the Selected point combo box drop-downs to specify the points you wish to collect, then click “Calculate =>” to see the Collection Point result.



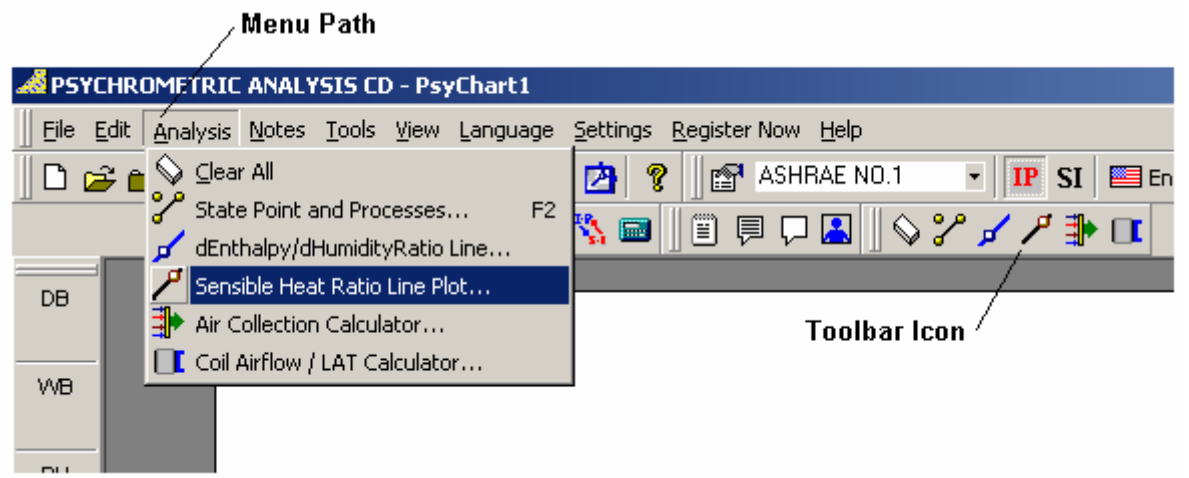
5. Type in the desired Point Label and click “Apply Point to Chart” to add the Collection Point to the chart and report.



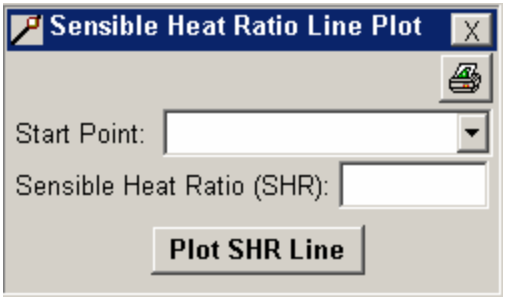
SENSIBLE HEAT RATIO LINE PLOTTING

1. NOTE: You need to have at least ONE point created BEFORE calculation of a constant sensible heat ratio line can be performed.

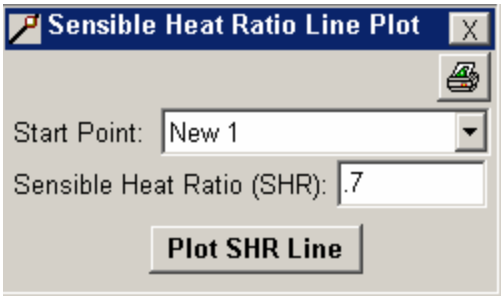
2. Activate "Sensible Heat Ratio Line Plot" by either of the two methods shown below:



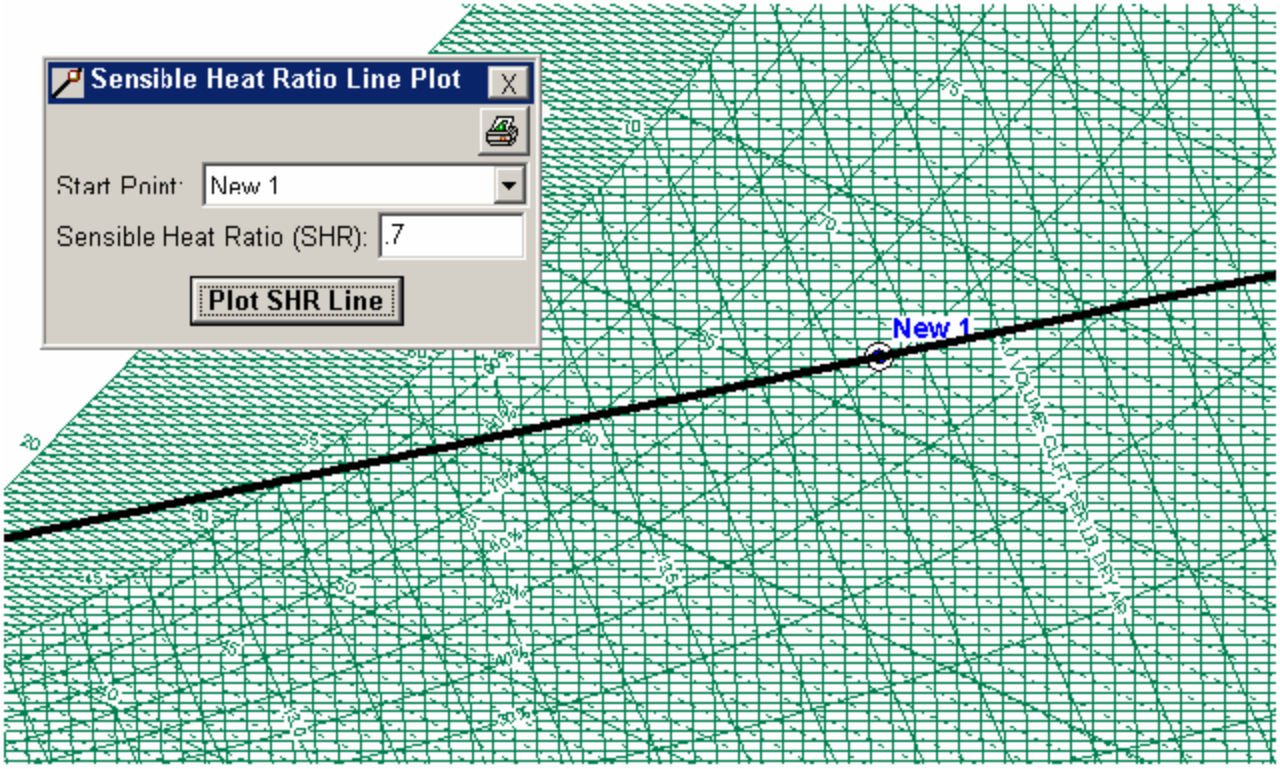
3. The Sensible Heat Ratio Line window appears with blank data fields.



4. Click the Start Point combo box drop-down to select a reference state point to plot through. Then type in the desired sensible heat ratio in the space provided.



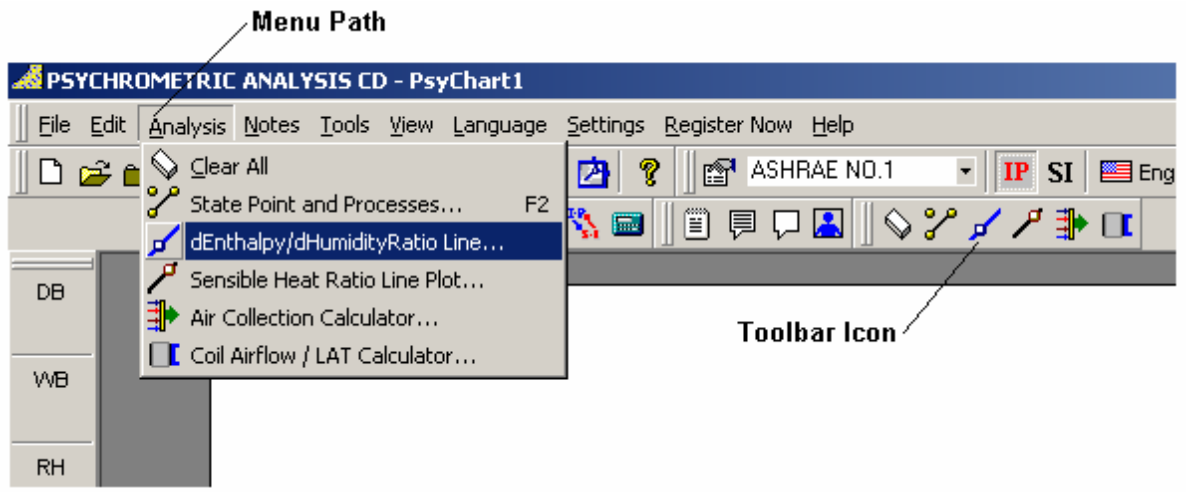
5. Click the “Plot SHR Line” and the SHR Line is automatically plotted across the chart.



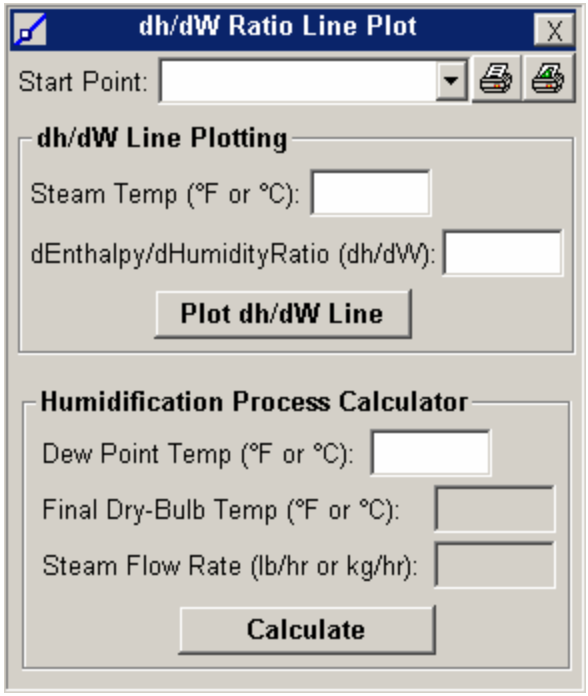
DELTA-h / DELTA-W LINE PLOTTING

1. NOTE: You need to have at least ONE point created BEFORE calculation of a constant delta-h / delta-W line can be performed.

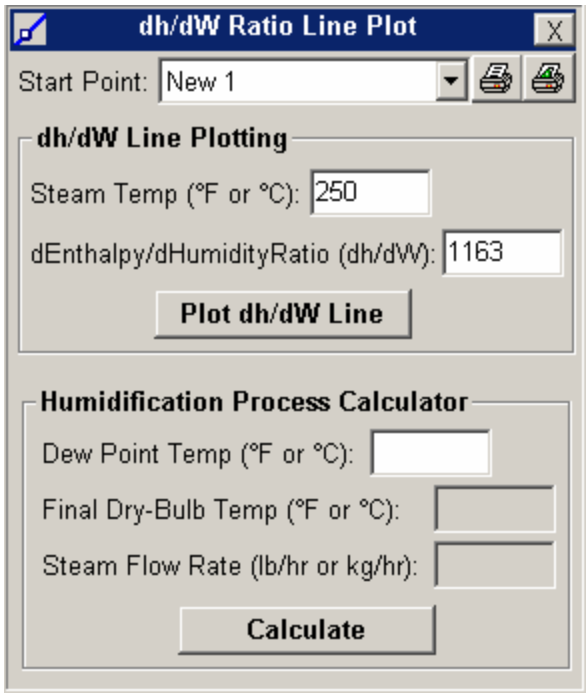
2. Activate "Delta-h / Delta-W Line Plot" by either of the two methods shown below:



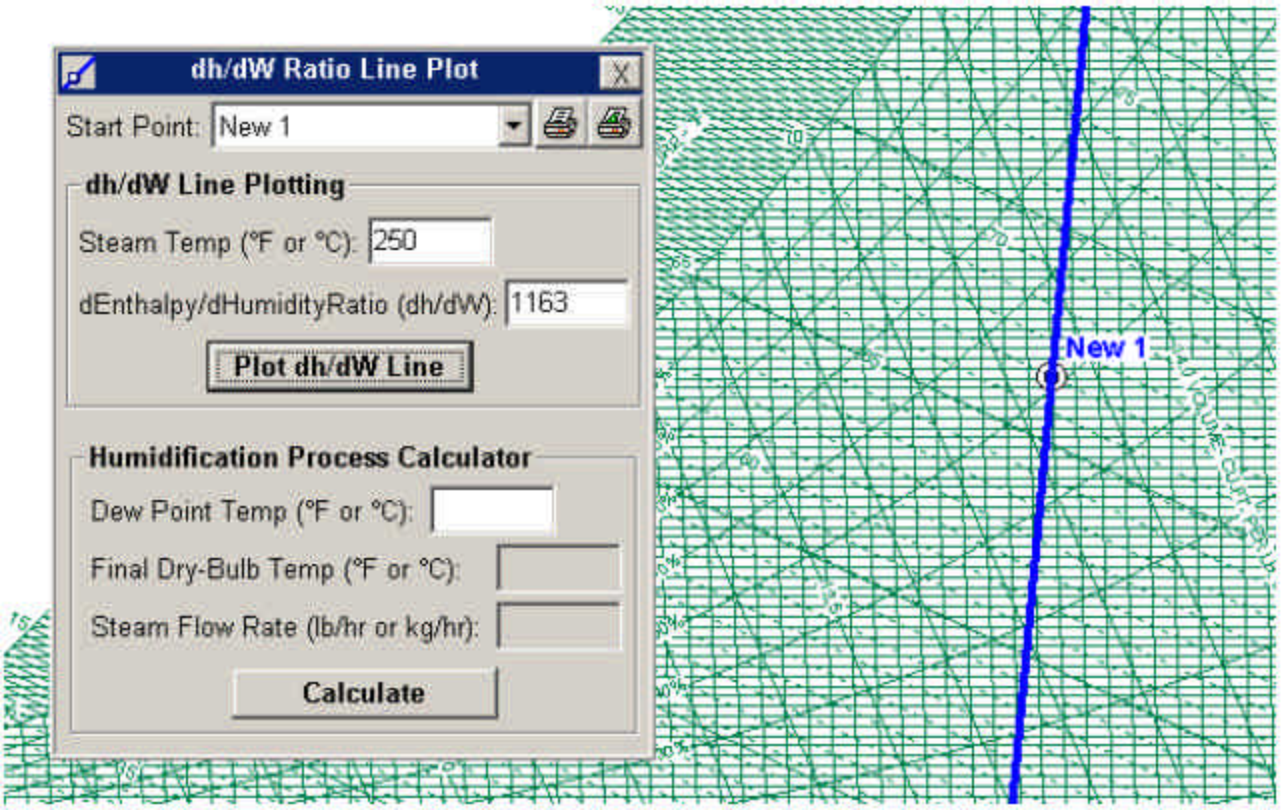
3. The Delta-h / Delta-W Line window appears with blank data fields.



4. Click the Start Point combo box drop-down to select the desired reference point and enter the “Steam Temperature” or “dh/dW” values in the space provided. Please note that which ever value isn’t provided, is automatically calculated real-time.



5. Click the “Plot dh/dW Line” and the Delta-h/Delta-W Line is automatically plotted across the chart.



6. Type the desired final Dew Point Temperature and click the “Calculate” button to see the resulting Final Dry-Bulb Temperature and Steam Flow Rate.

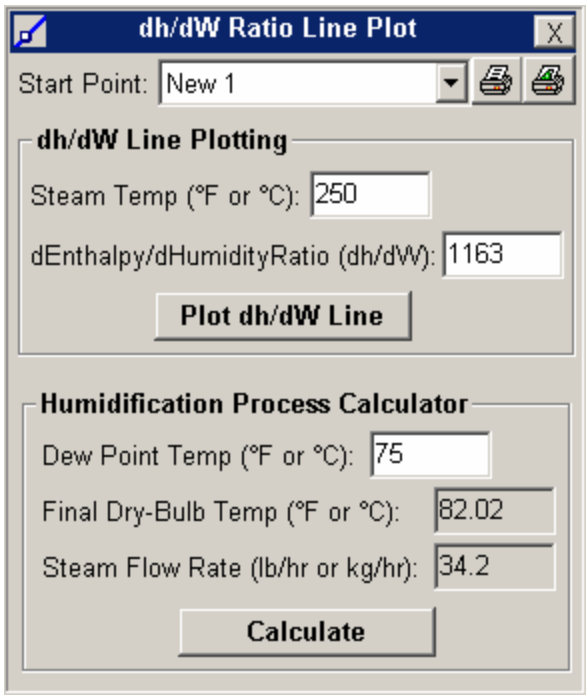
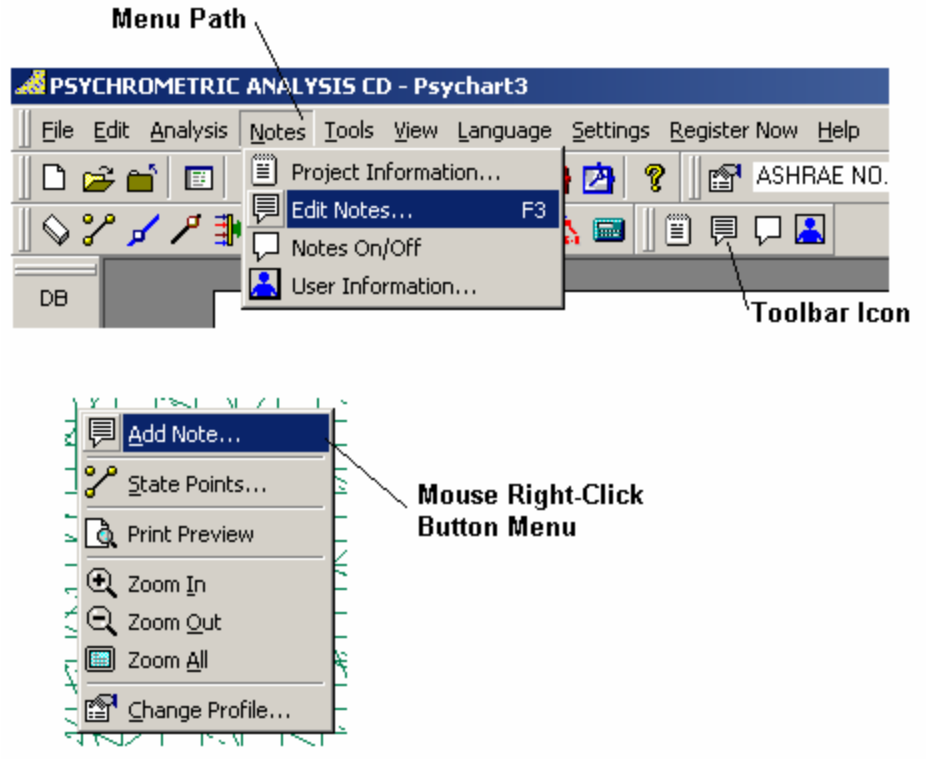
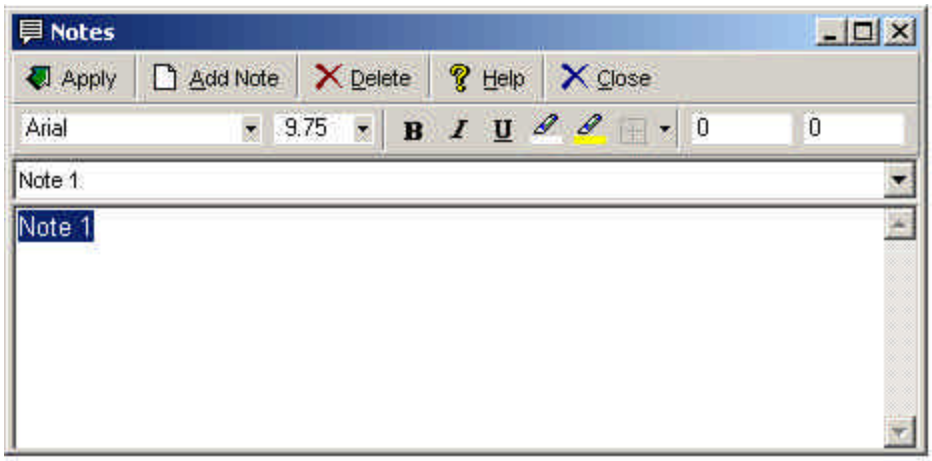

dh/dW Ratio Line Plot
Start Point: New 1
dh/dW Line Plotting
Steam Temp (°F or °C): 250
dEnthalpy/dHumidityRatio (dh/dW): 1163
Plot dh/dW Line
Humidification Process Calculator
Dew Point Temp (°F or °C): 75
Final Dry-Bulb Temp (°F or °C): 82.02
Steam Flow Rate (lb/hr or kg/hr): 34.2
Calculate

CHART NOTES

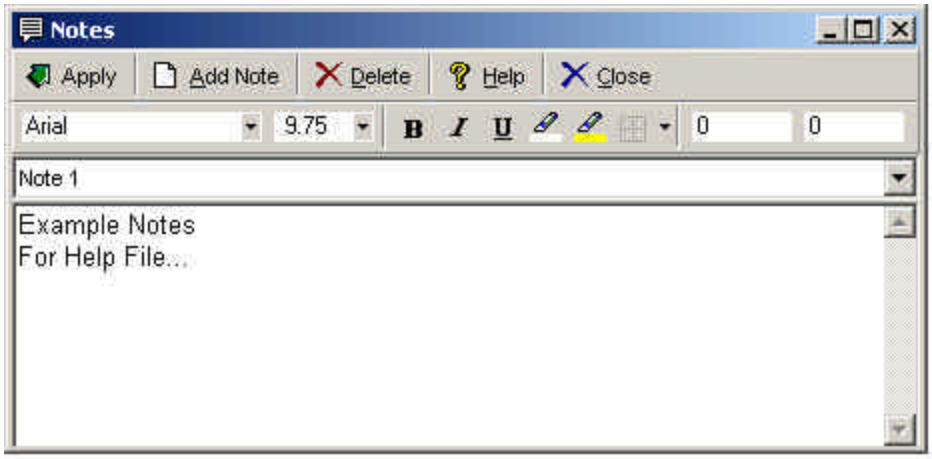
1. Activate "Notes" by any of the three methods shown below or press 'F3':



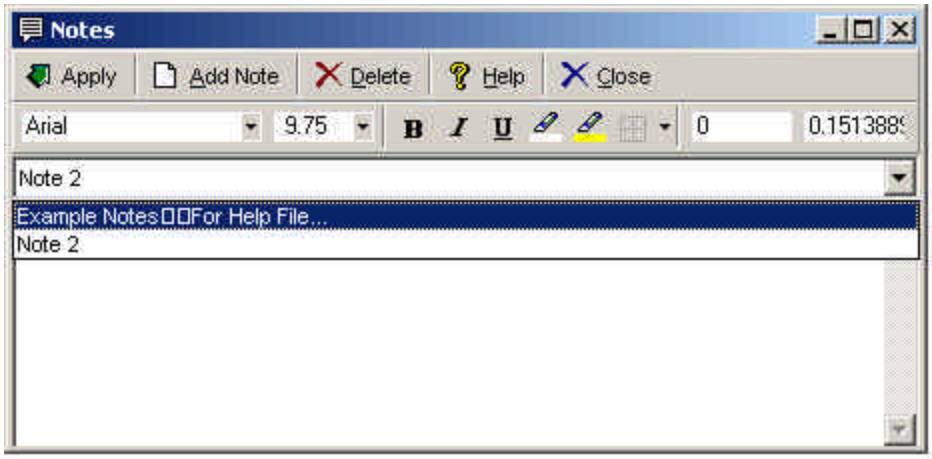
2. The Notes window appears with New Note #1 as the current note.



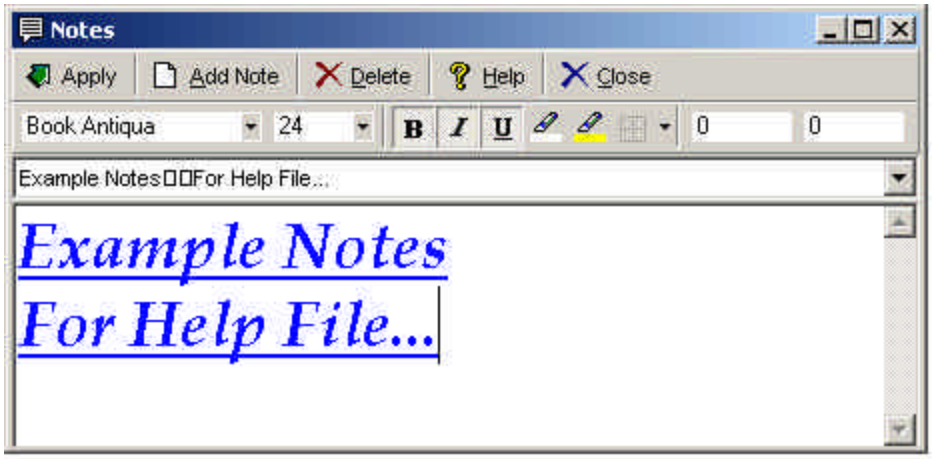
3. To create a new note, enter the desired note text in the "Note Text" field.



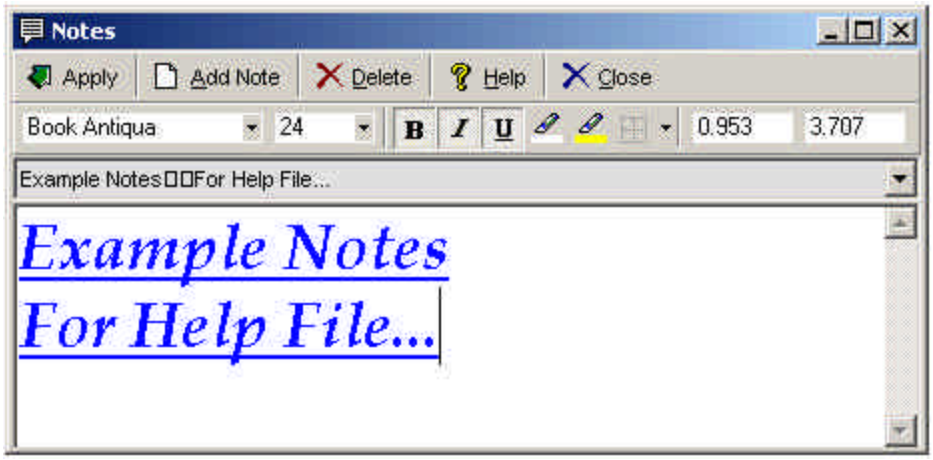
4. To edit an existing note, click the "Selected Note Name" drop-down and select the desired existing Note to be edited from the list. Enter the "Note Text" field to make any text revisions.



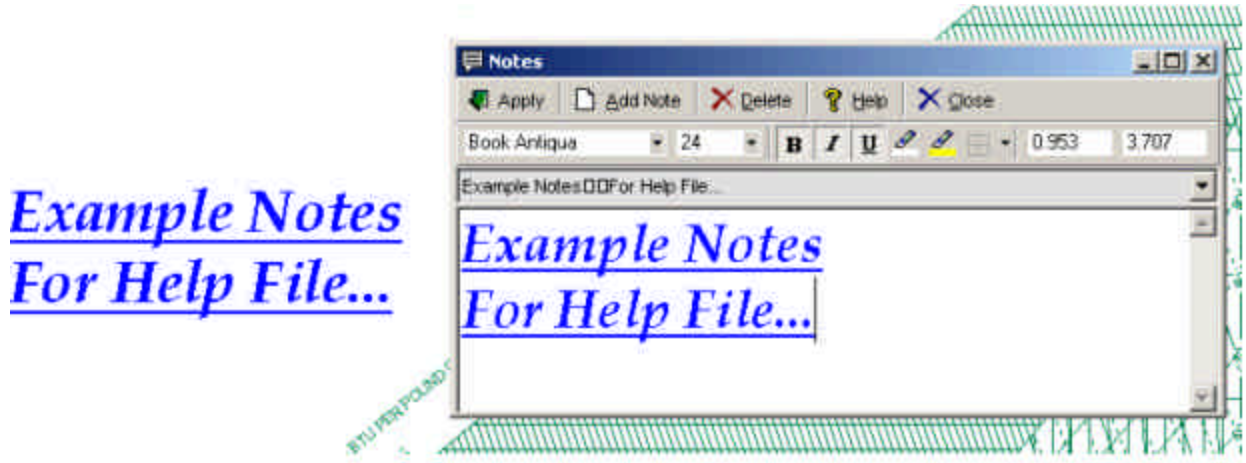
5. Adjust the font settings (Font Name, Font Size, Bold, Italic, Underline, Color) as desired.



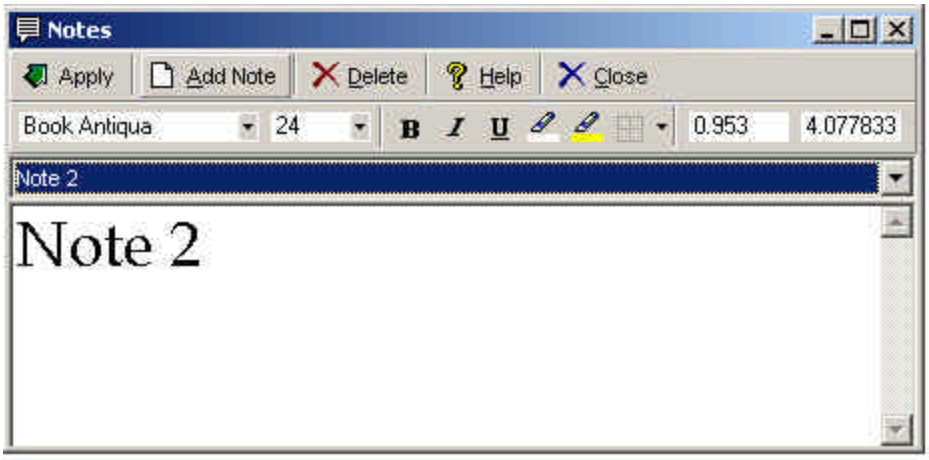
6. Enter the Note X & Y location by either typing the X & Y coordinates in to the appropriate fields or use the left mouse button and click once on the chart, move the mouse to see the coordinates track the mouse location and when the mouse is at the desired location, perform a left mouse button single click again to set the coordinates. See Above graphic.



7. Click the "Apply" button and the note will appear on the chart:



8. The Note window remains open. To add additional notes, simply click the "New" button and you're ready to begin your next note.



9. Psychrometric Analysis allows an unlimited amount of notes to be entered. Each note can have its own properties. All information is saved to the project file. The Notes window accepts the information you want to place on the chart, allows font changes and provides a means to position the information.

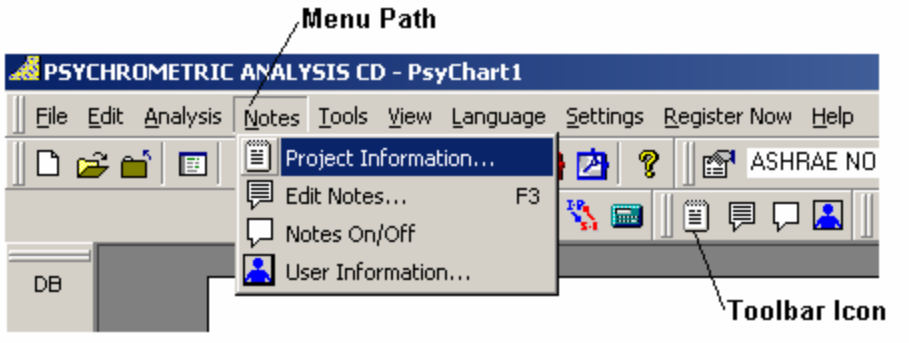
10. Enter your notes in the text box. Use any of the font buttons to adjust the settings. Set the position by clicking on the chart or using the X and Y position settings provided in text box. Now click "Apply" to add the project information to the chart.

11. You may want to change the position of the information on the chart after you see it. While the Notes window is open you may do so by making a single click on the information and then another single click at the new location. To edit the information, make the changes in the Notes window and click "Apply".

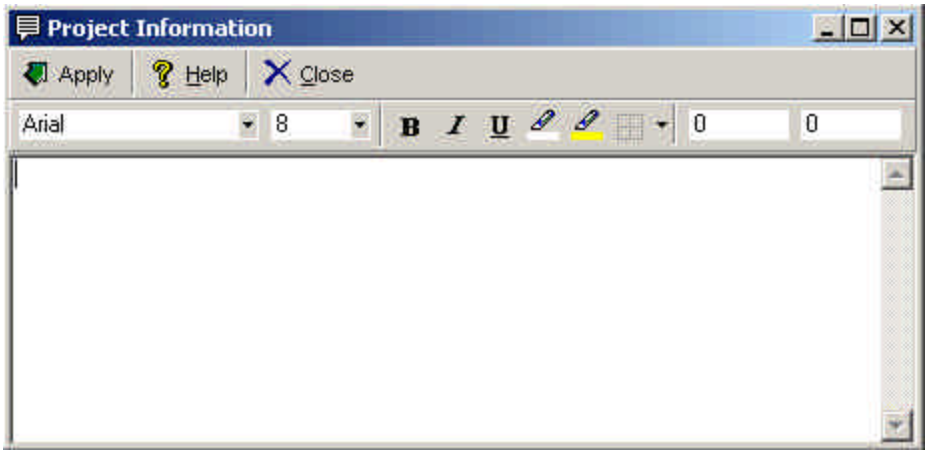
12. You may edit this information, change its font or position at any time. Simply open the Notes window and make the changes.

PROJECT INFORMATION NOTE

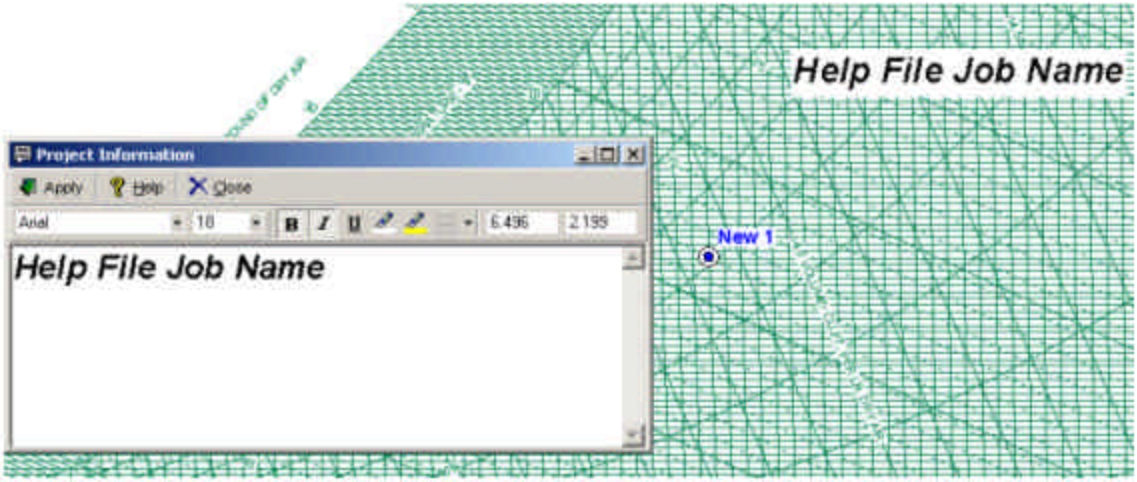
1. Activate "Project Information" by any of the two methods shown below.



2. The Project Information window appears ready to receive the Project Name as the current note. Please note that this note will appear on the state point reports as the Project Name.

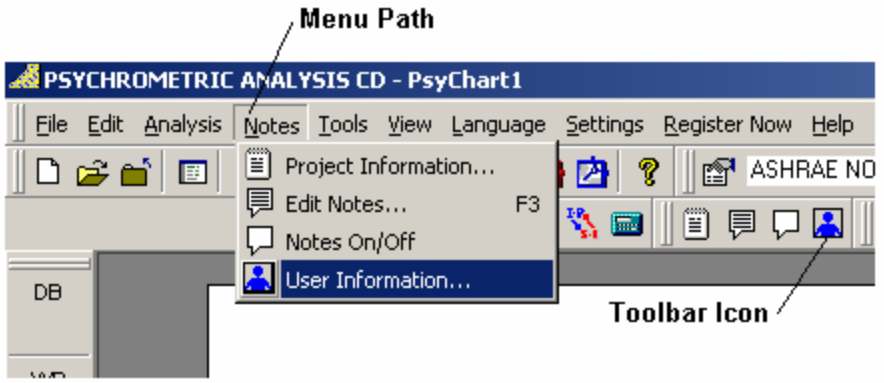


3. Type in the project name you wish, adjust fonts, location, etc. When finished, click the "Apply" button to automatically place on the chart.

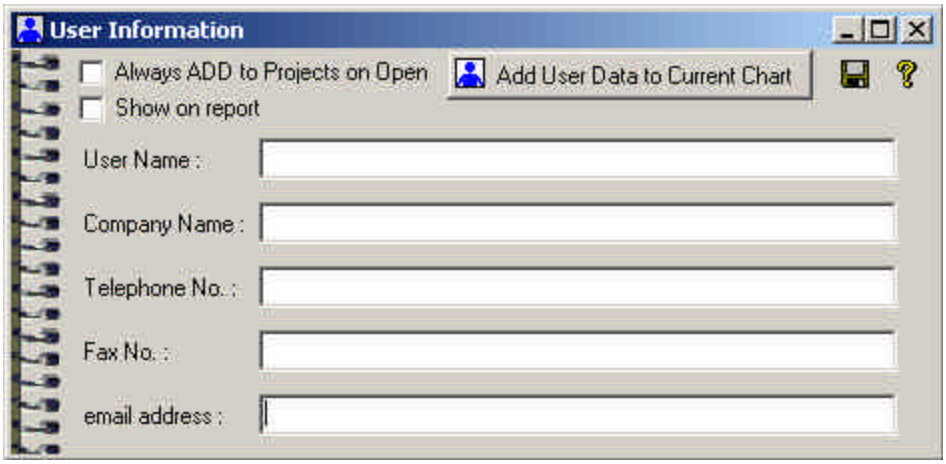


USER INFORMATION NOTE

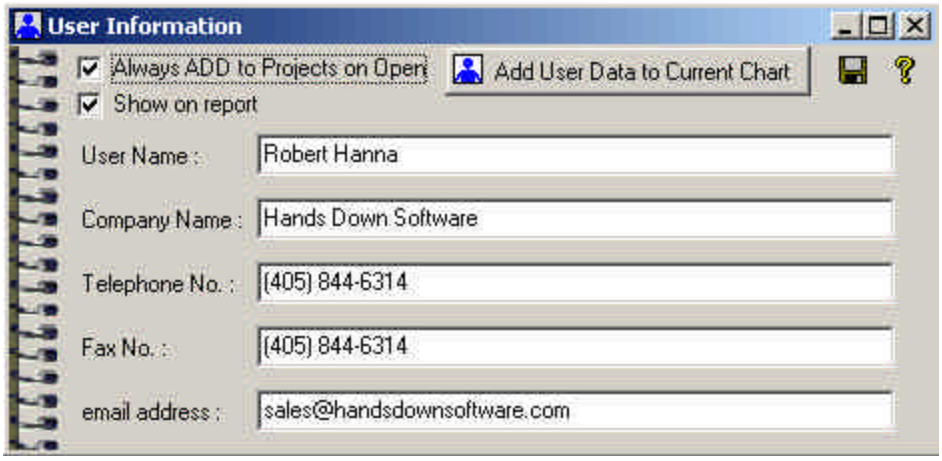
1. Activate "User Information" by either of the two methods shown below.



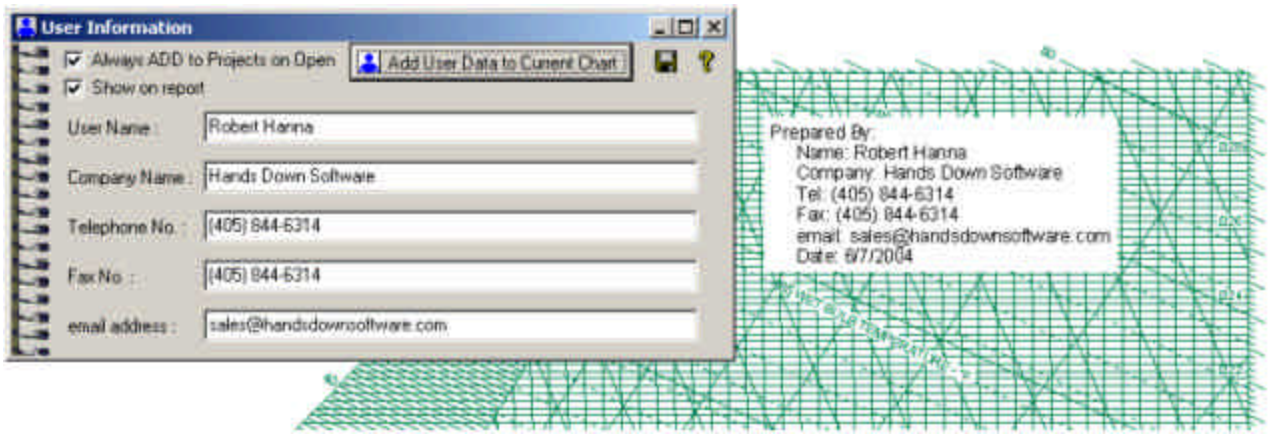
2. The User Information window appears as shown below:



3. Type in your information in the space providing. Check the display options you wish to choose for your default.



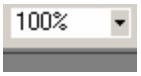
4. Click the “Save” button in the upper right hand corner. You may also click the “Add User Data to Current Chart” button to have your user information displayed on the current chart.



ZOOMING AND PANNING

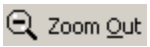
Zoom IN

1. Click View on the menu bar, then click the Zoom In icon.
2. Click the Zoom In icon on the toolbar.
3. Enter the Zoom Percent into the zoom factor dropdown on the toolbar.

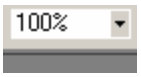


4. Move your mouse so the cursor is on the chart and **Double-Click** the **LEFT** mouse button.

Zoom OUT



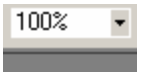
1. Click View on the menu bar, then click the Zoom Out icon.
2. Click the Zoom Out icon on the toolbar.
3. Enter the Zoom Percent into the zoom factor dropdown on the toolbar.



4. Move your mouse so the cursor is on the chart and **Double-Click** the **RIGHT** mouse button.

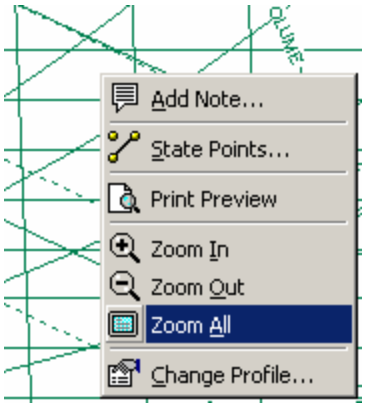
Zoom ALL

1. Click View on the menu bar, then click the Zoom All icon.
2. Click the Zoom All icon on the toolbar.
3. Enter 100 into the zoom factor dropdown on the toolbar.



Zoom MENU

1. Move your mouse so the cursor is on the chart and **Single-Click** the **RIGHT** mouse button and click the Zoom action icon on the pop-up menu.



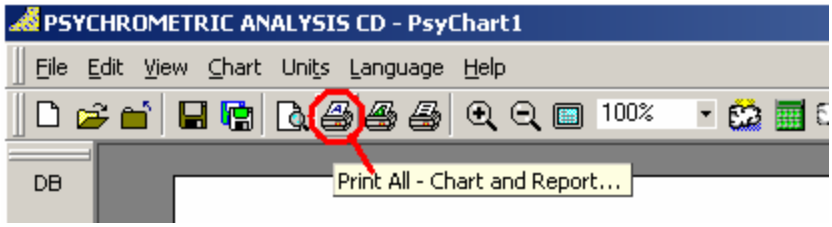
Panning

If you are ZOOMED IN on the chart, simply position your mouse on the chart and hold the LEFT mouse button down and move your mouse. When you have panned to the desired position, release the left mouse button.

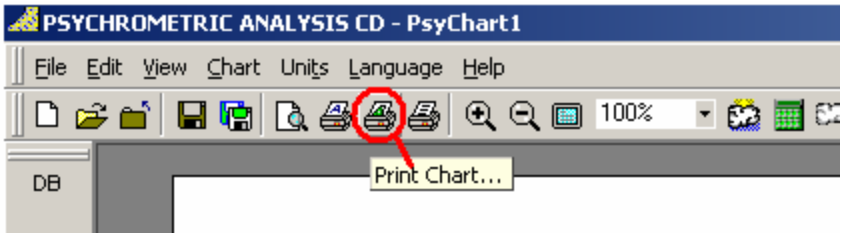
PRINTING

There are four different choices when printing:

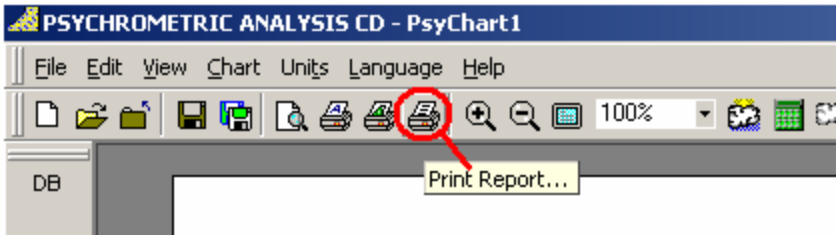
1. Print BOTH the Chart and Report. Click on the Print All icon on the toolbar.



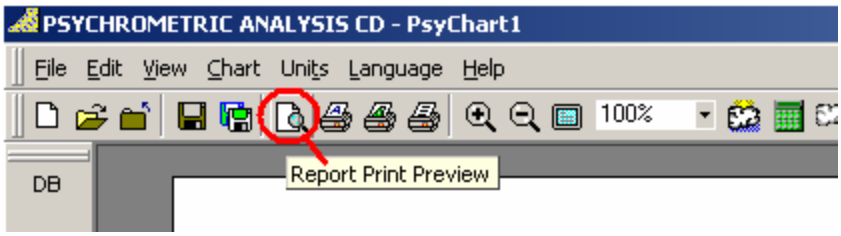
2. Print ONLY the Chart. Click on the Print Chart icon on the toolbar.



3. Print ONLY the Report. Click on the Print Report icon on the toolbar.

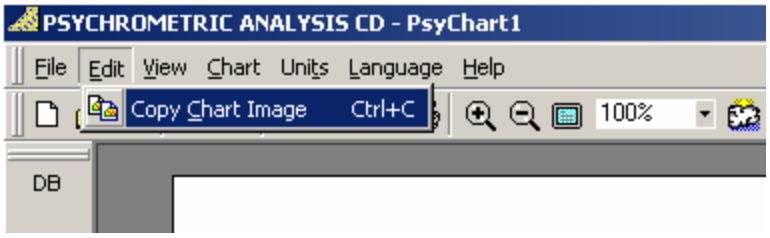


4. Print Preview ONLY the Report. Click on the Report Print Preview icon on the toolbar.



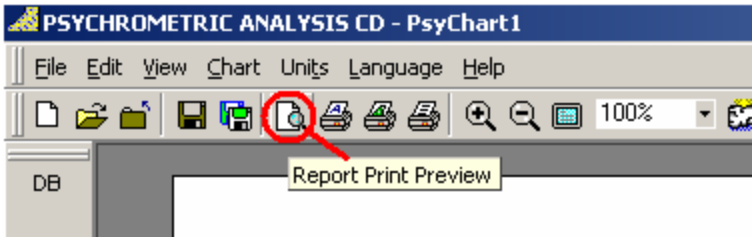
EXPORT/COPY CHART

From the menu, click on Edit, and then click Copy Chart Image. The psychrometric chart image is automatically placed on your clipboard for you to paste into your reports, presentations, proposals, etc.

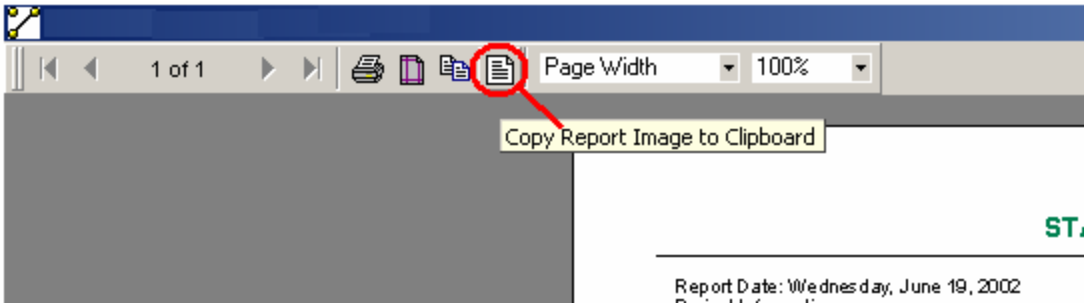


EXPORT/COPY REPORT

From the toolbar, click the Report Print Preview icon.

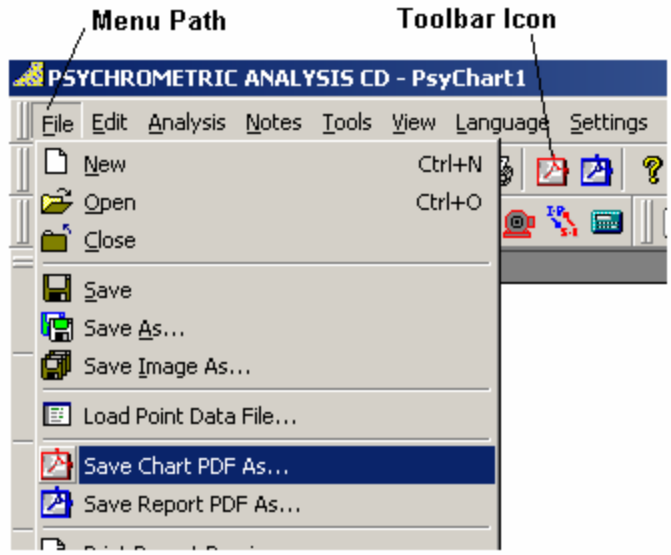


Then from the toolbar on the Report Print Preview, click the Copy Report Data to Clipboard icon. The complete state-point and process report image is automatically placed on your clipboard for you to paste into your reports, presentations, proposals, etc.

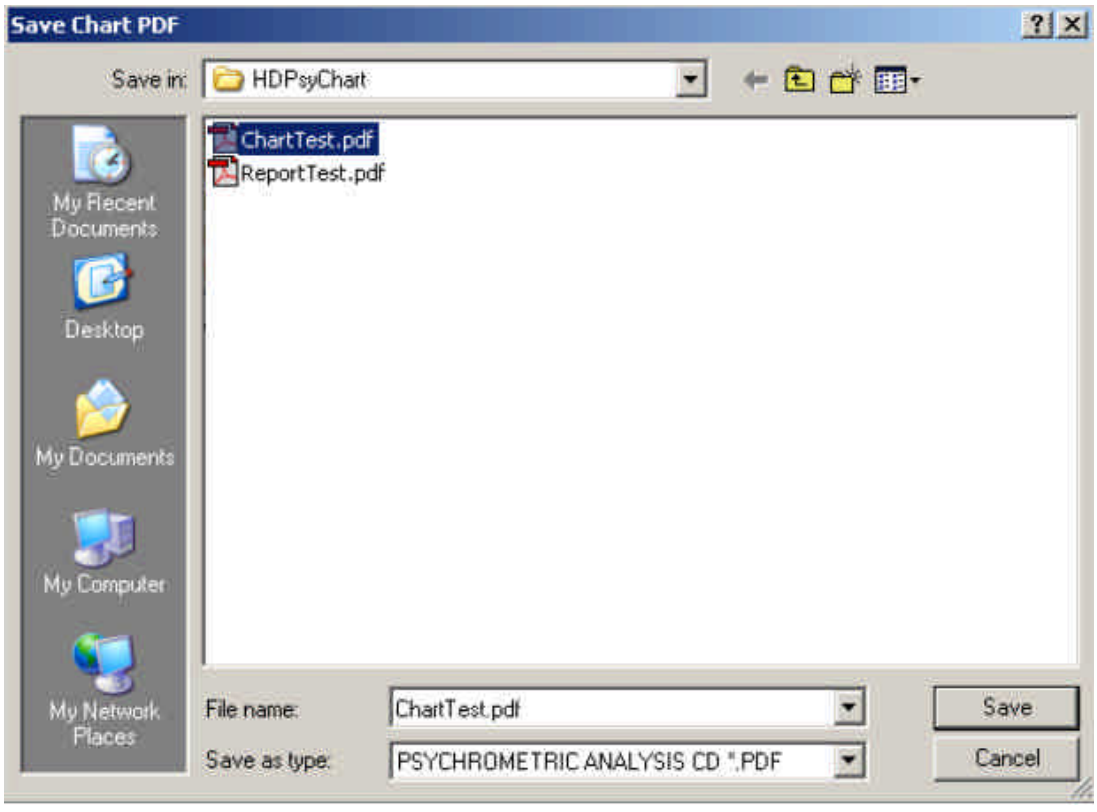


EXPORT/CREATE CHART PDF

1. Activate "Save Chart PDF As…" by either of the two methods shown below:

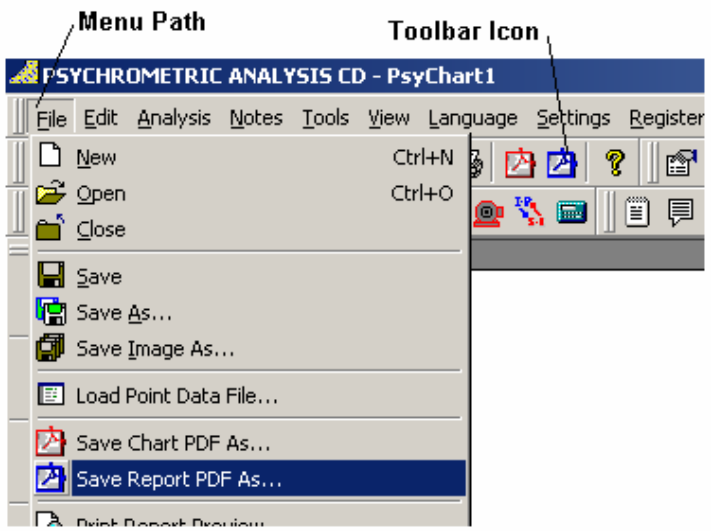


2. Navigate to where you want to save the file, type in the file name and click the “Save” button.

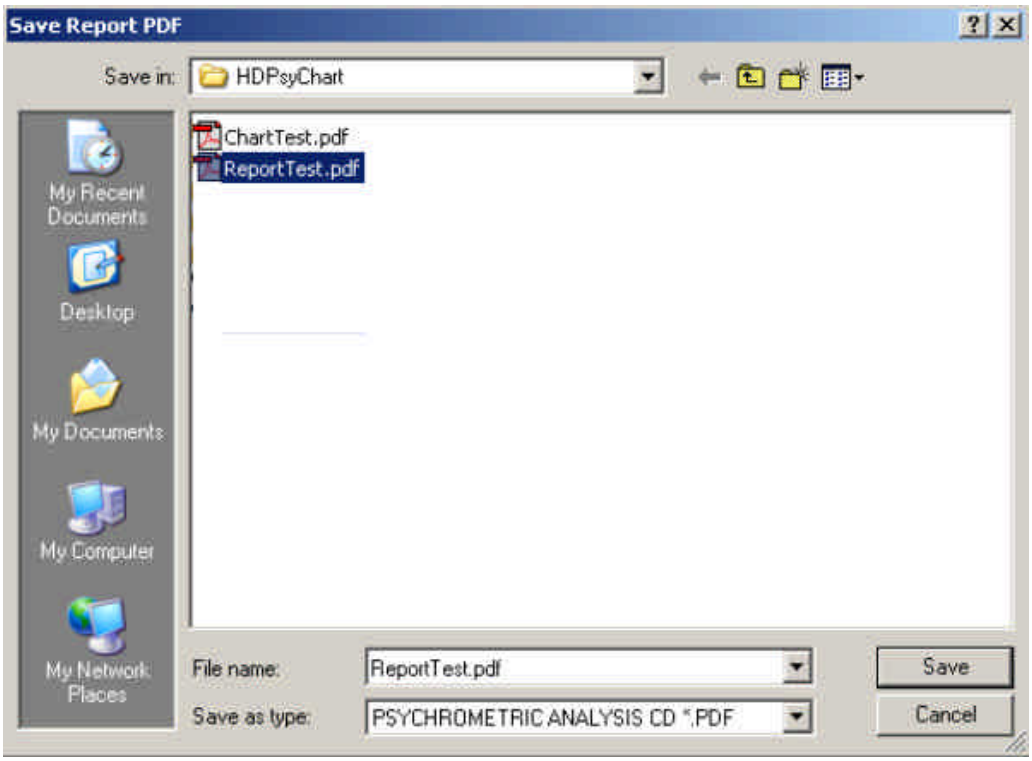


EXPORT/COPY REPORT PDF

1. Activate "Save Report PDF As…" by either of the two methods shown below:

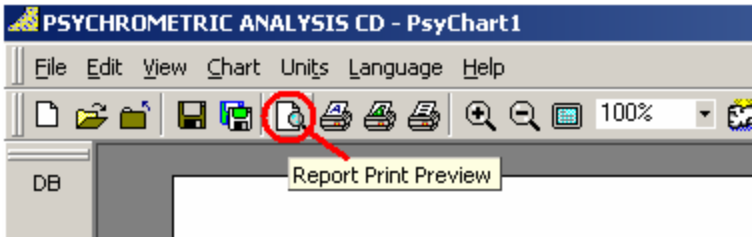


2. Navigate to where you want to save the file, type in the file name and click the “Save” button.

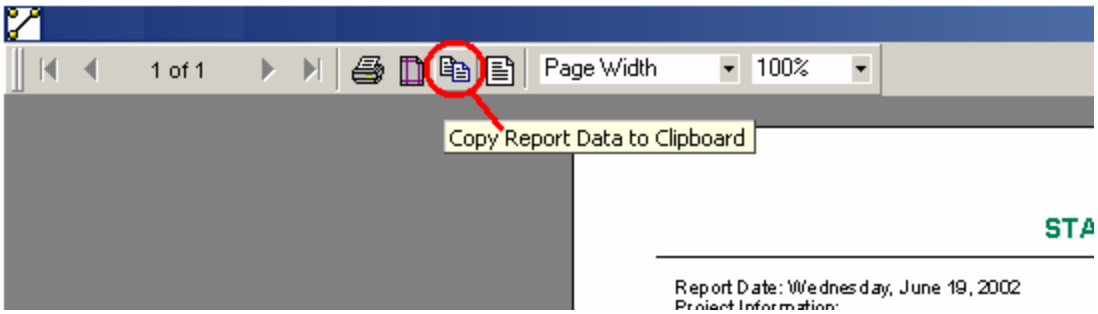


EXPORT/COPY REPORT DATA

From the toolbar, click the Report Print Preview icon.

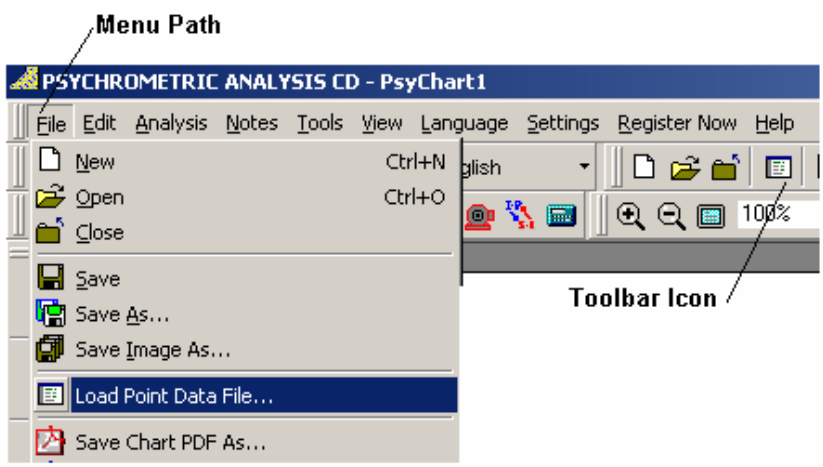


Then from the toolbar on the Report Print Preview, click the Copy Report Data to Clipboard icon. The complete state-point and process report data is automatically placed on your clipboard for you to paste into your reports, presentations, spreadsheets, etc.

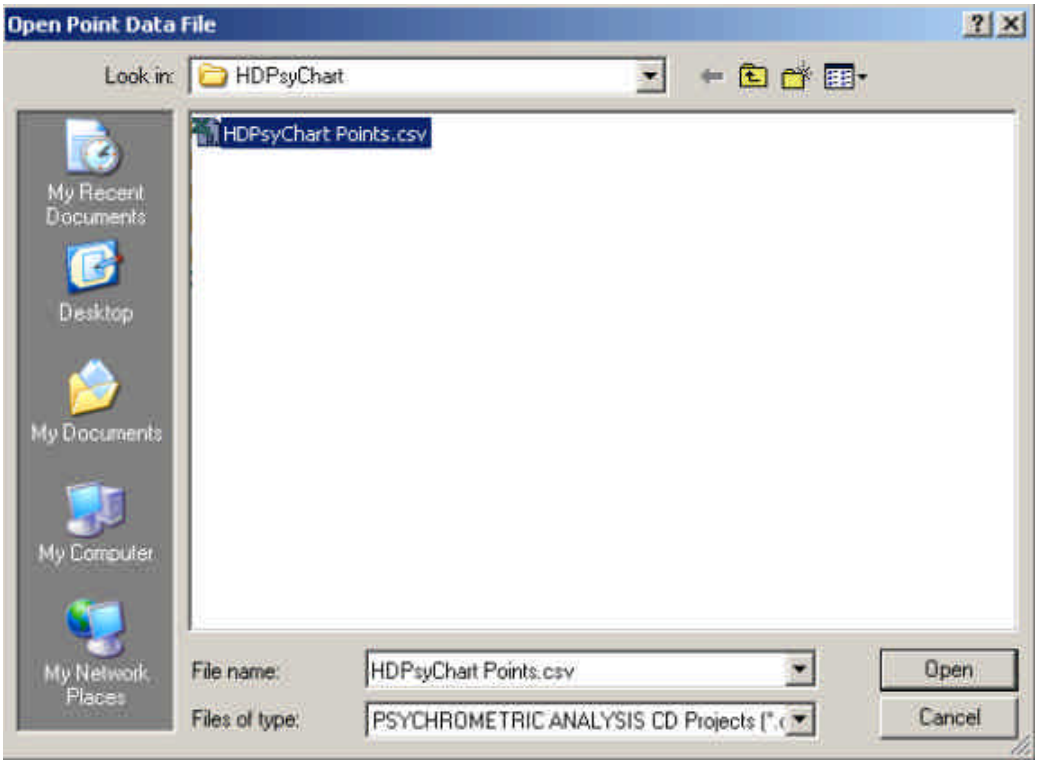


IMPORTING DATA

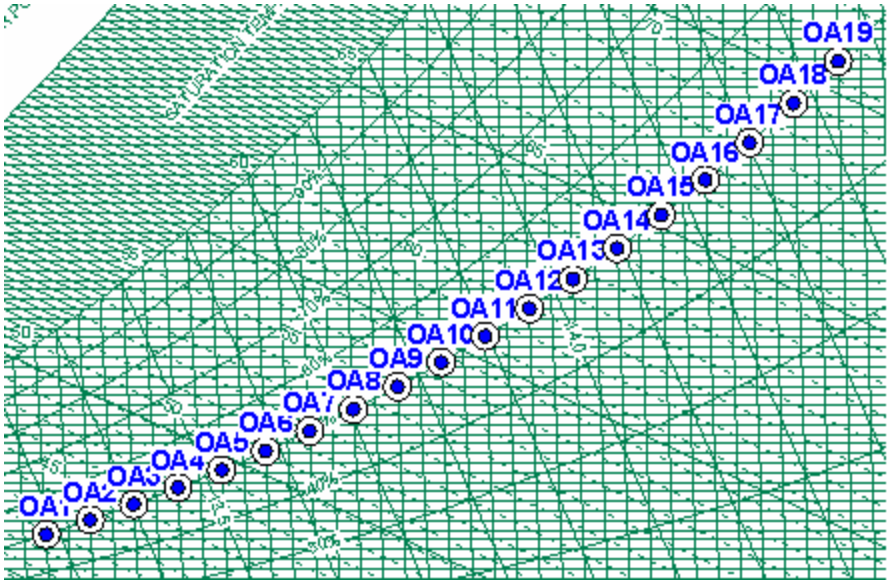
From the toolbar, click the Import Data File icon.



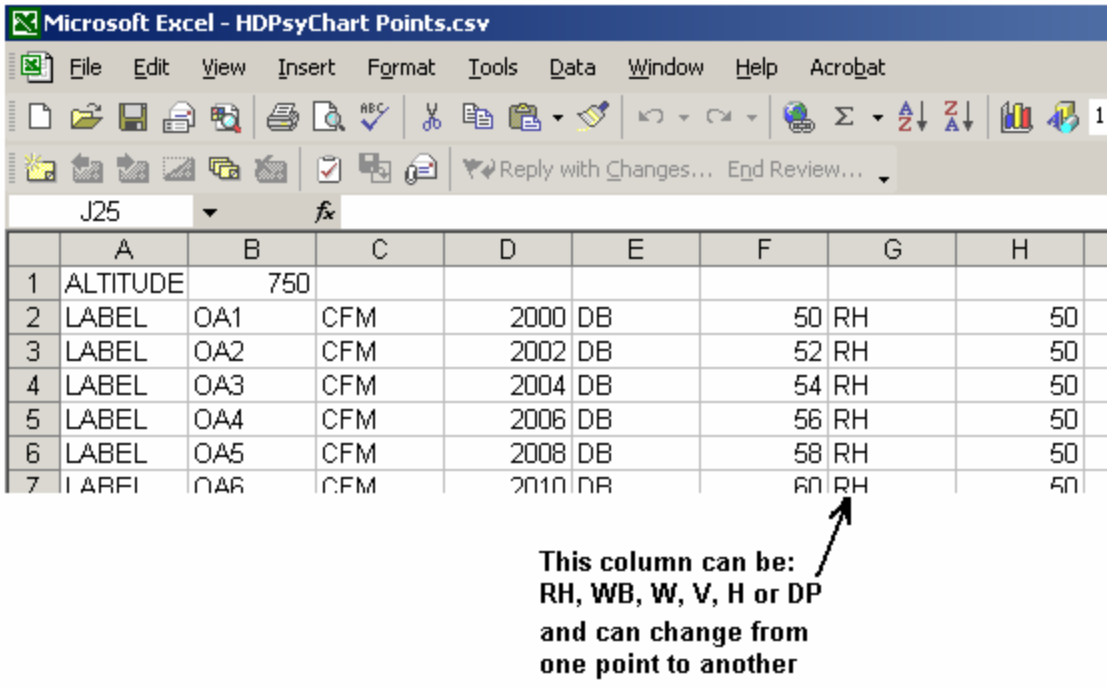
Then navigate to the ".csv" file with the data you wish to import. ".csv" file format is a comma delimited file format, which is an export option for spreadsheet programs such as Microsoft Excel.



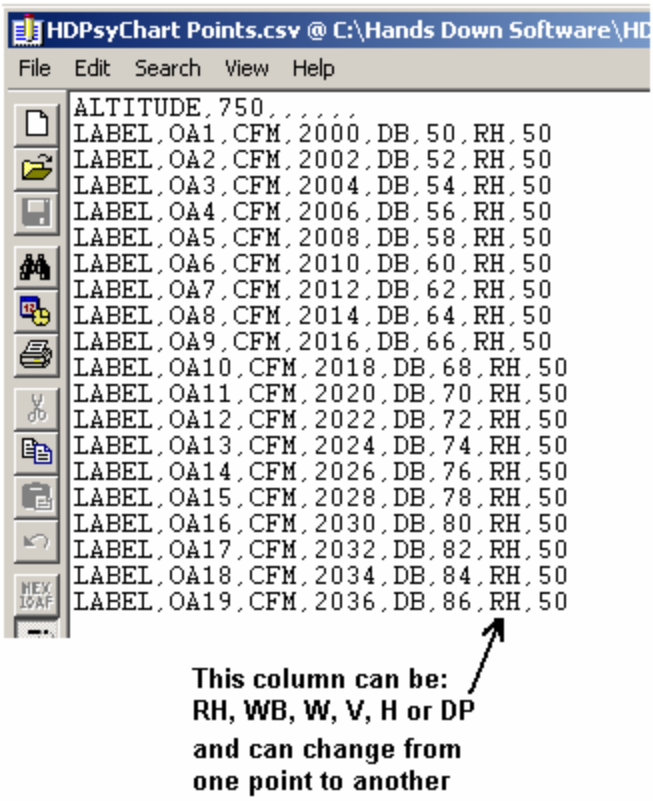
Then Click the “Open” button and the data points will be imported and displayed on the chart. Below is an example shipped with this program:



If using a Spreadsheet to create the “.csv” file, data points must be set up with the following structure:

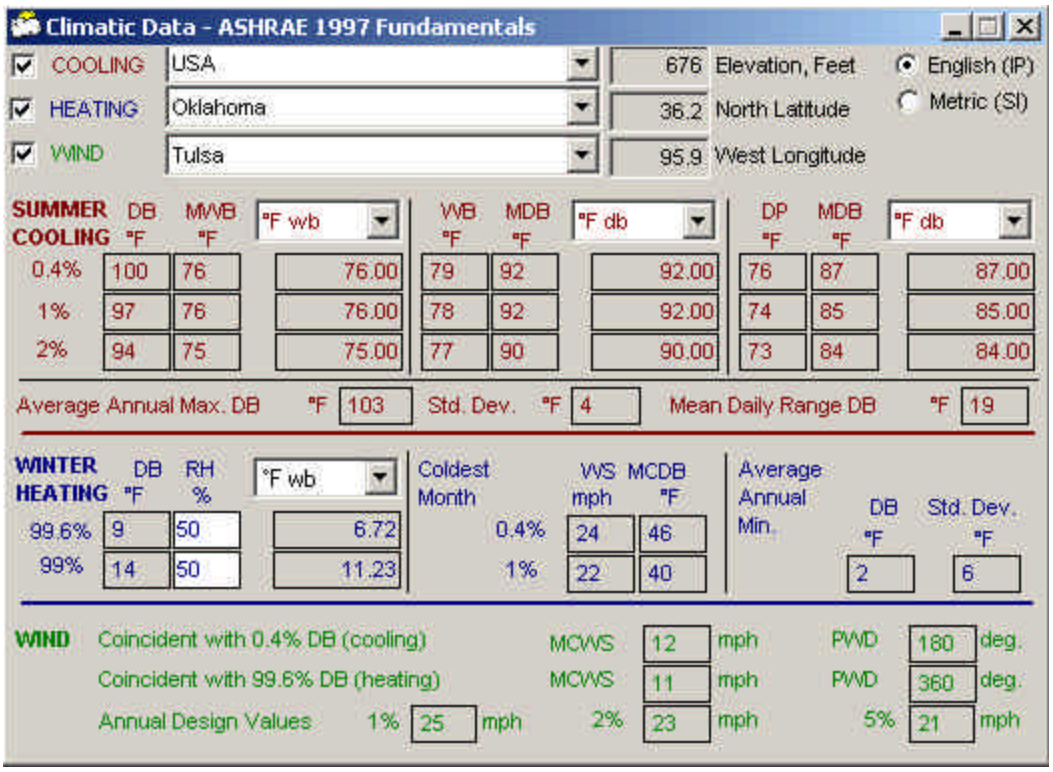

Microsoft Excel - HDPsyChart Points.csv
File Edit View Insert Format Tools Data Window Help Acrobat
Reply with Changes... End Review...
J25
A B C D E F G H
1 ALTITUDE 750
2 LABEL OA1 CFM 2000 DB 50 RH 50
3 LABEL OA2 CFM 2002 DB 52 RH 50
4 LABEL OA3 CFM 2004 DB 54 RH 50
5 LABEL OA4 CFM 2006 DB 56 RH 50
6 LABEL OA5 CFM 2008 DB 58 RH 50
This column can be:
RH, WB, W, V, H or DP
and can change from
one point to another

If using a text editor to create the ".csv" file, data points must be set up with the following structure:



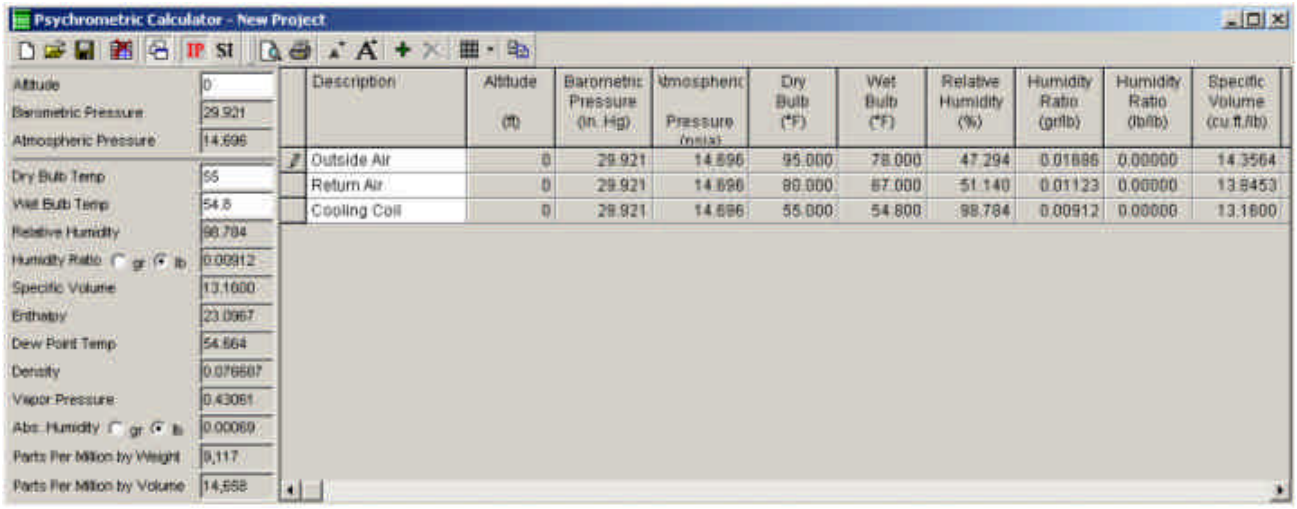
CLIMATIC DATA

Climatic Data provides ambient design conditions for over 1,000 locations in either IP or SI units of measure. Ambient data is from ASHRAE 1997 Fundamentals.

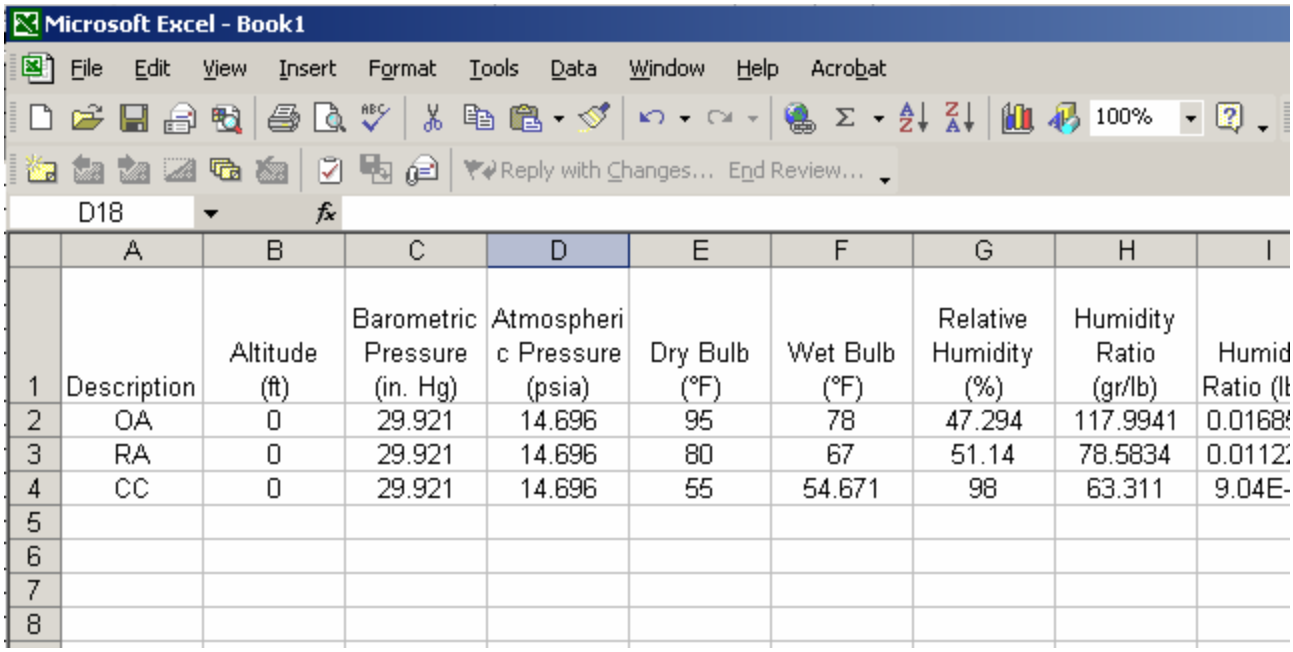


PSYCHROMETRIC CALCULATOR

Complete stand-alone psychrometric calculator is one of the tools provided. This psychrometric wonder has full File-Open-Save-SaveAs capabilities.


Psychrometric Calculator - New Project
Altitude 0
Barometric Pressure 29.921
Atmospheric Pressure 14.696
Dry Bulb Temp 55
Wet Bulb Temp 54.8
Relative Humidity 98.784
Humidity Ratio gr lb 0.00912
Specific Volume 13.1600
Enthalpy 23.0967
Dew Point Temp 54.664
Density 0.076687
Vapor Pressure 0.43061
Abs. Humidity gr lb 0.00069
Parts Per Million by Weight 9,117
Parts Per Million by Volume 14,658
Description
Altitude (ft)
Barometric Pressure (in. Hg)
Atmospheric Pressure (psia)
Dry Bulb (°F)
Wet Bulb (°F)
Relative Humidity (%)
Humidity Ratio (gr/lb)
Humidity Ratio (lb/lb)
Specific Volume (cu ft/lb)
Outside Air 0 29.921 14.696 95.000 78.000 47.294 0.01686 0.00000 14.3564
Return Air 0 29.921 14.696 80.000 67.000 51.140 0.01123 0.00000 13.9453
Cooling Coil 0 29.921 14.696 55.000 54.800 98.784 0.00912 0.00000 13.1600

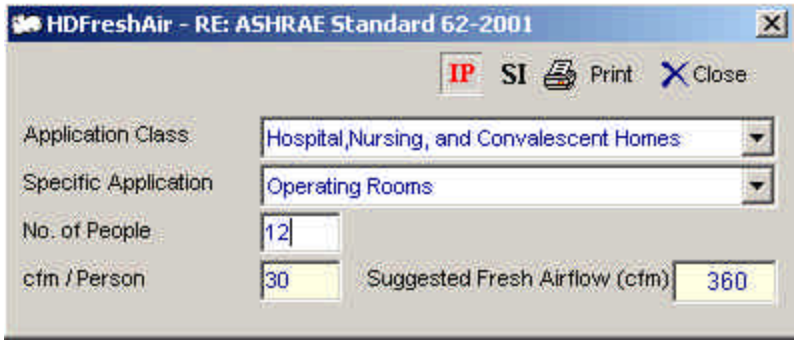
The program also has a data report for printing and the ability to copy all data points to the clipboard so you can paste them into your reports or spreadsheets.


Microsoft Excel - Book1
File Edit View Insert Format Tools Data Window Help Acrobat
100%
Reply with Changes... End Review...
D18

	A	B	C	D	E	F	G	H	I
1	Description	Altitude (ft)	Barometric Pressure (in. Hg)	Atmospheric Pressure (psia)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Humid Ratio (lb
2	OA	0	29.921	14.696	95	78	47.294	117.9941	0.0168
3	RA	0	29.921	14.696	80	67	51.14	78.5834	0.0112
4	CC	0	29.921	14.696	55	54.671	98	63.311	9.04E-
5									
6									
7									
8									

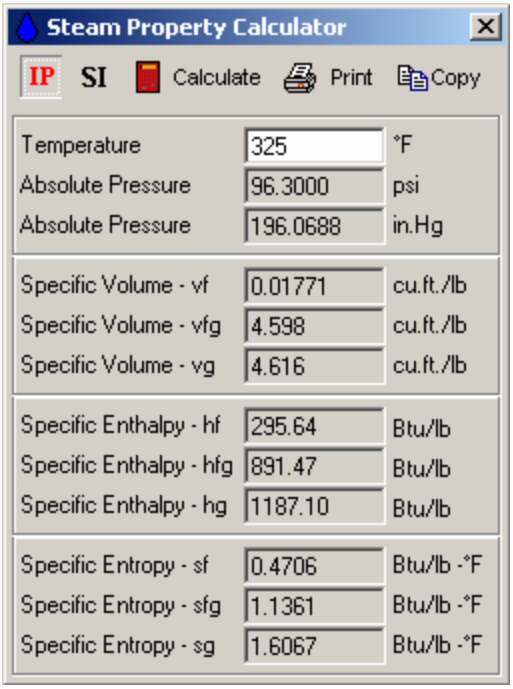
OUTSIDE AIR ESTIMATOR

Complete stand-alone fresh air estimator is one of the tools provided. This tool has many of the applications listed in ASHRAE Standard 62-2001.



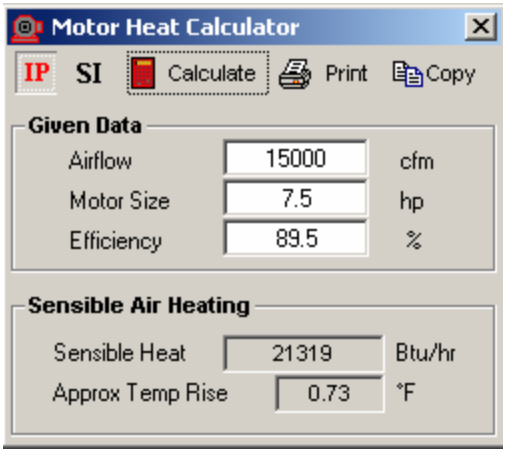
STEAM PROPERTY CALCULATOR

Complete steam property calculator is one of the tools provided. This tool provides complete thermo-physical properties of steam for both IP & SI units of measure.



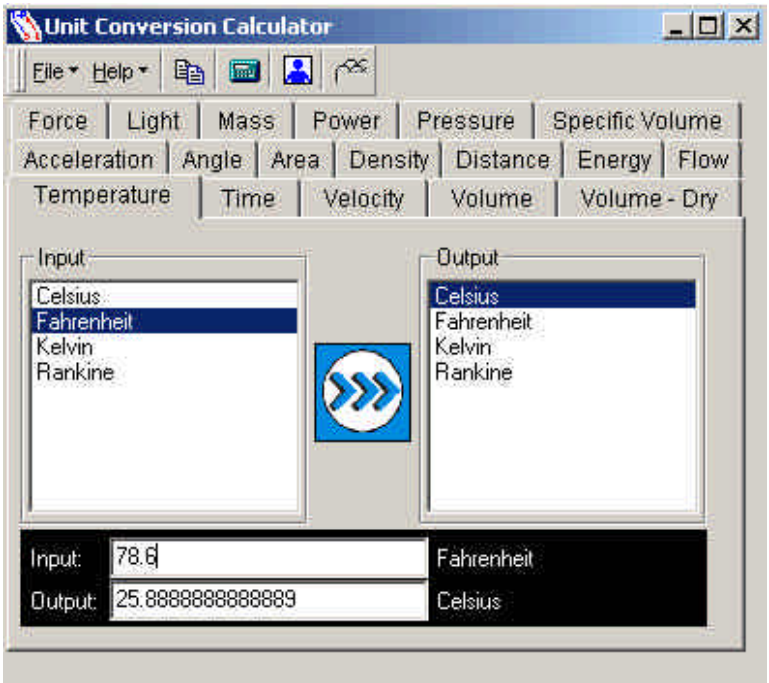
MOTOR HEAT CALCULATOR

Sensible Heat generated by motors in the air stream can now be easily calculated. This Motor Heat Calculator is one of the tools provided. Simply input three variables and click calculate. Calculates sensible heat and temperature rise for both IP & SI units of measure.



UNIT CONVERSION CALCULATOR

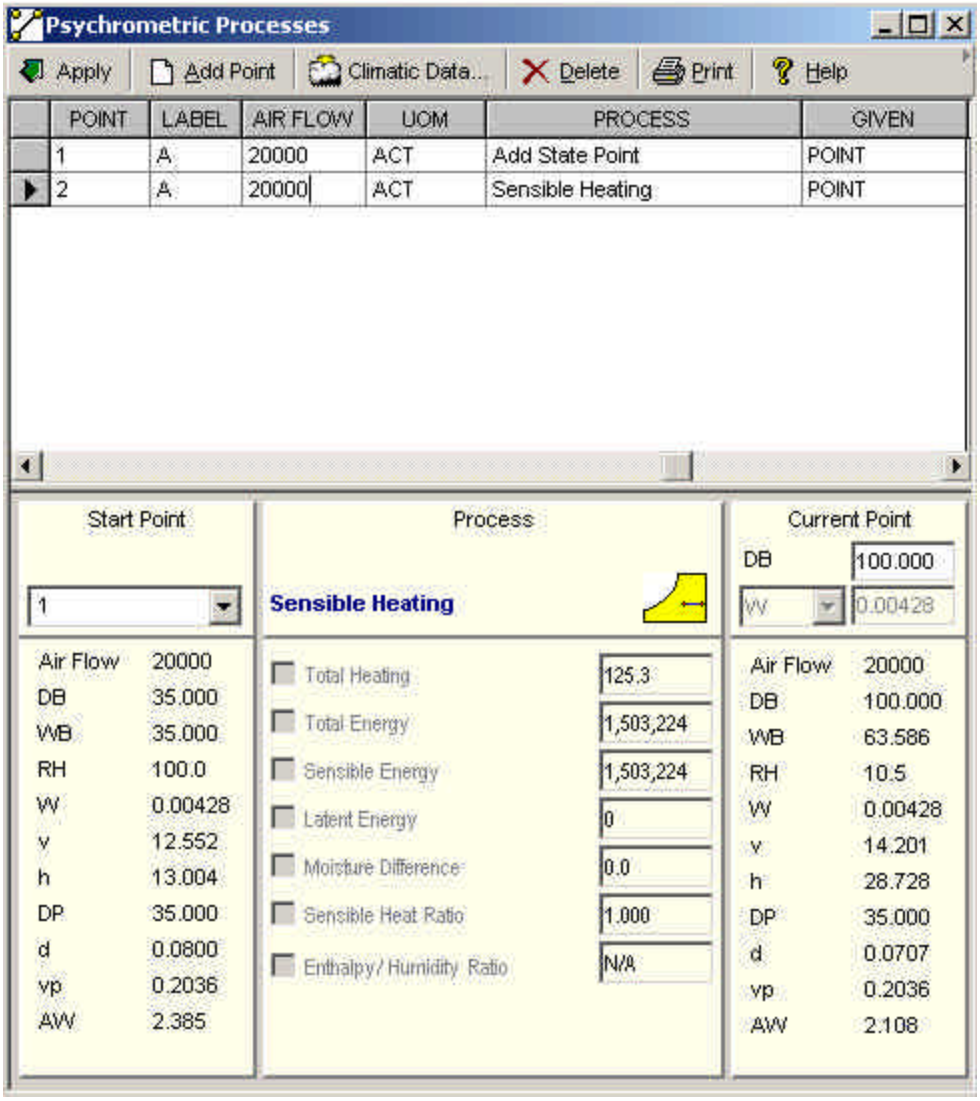
This Unit of Measure converter is one of the tools provided. Simply click on the unit category and then click on the source and target units of measure and type in your value, resulting in real time conversion. This tool also allows the user complete Category Tab Management, unit of measurement management and conversion equation management.



EXAMPLE 1:
Moist Air Sensible Heating

Saturated air at 35F enters a heating coil at 20,000cfm. Air leaves coil at 100F. Find the required rate of heat addition.

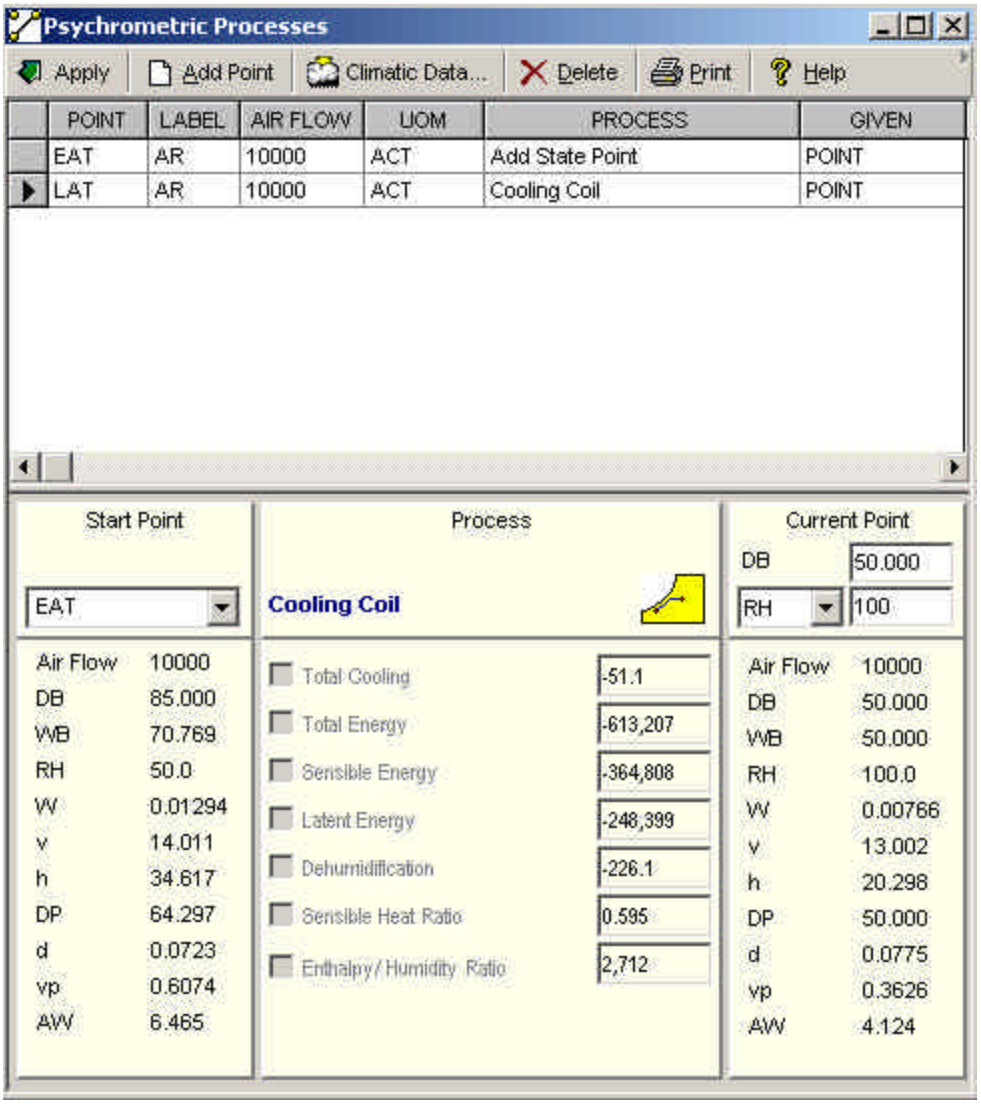
Solution: 1,503,224 Btu/h



EXAMPLE 2:
Moist Air Cooling & Dehumidification

Problem: Moist air at 85F dry bulb and 50% rh enters a cooling coil at 10,000 cfm and is processed to a final condition at 50F and 100% rh. Find the tons of refrigeration required.

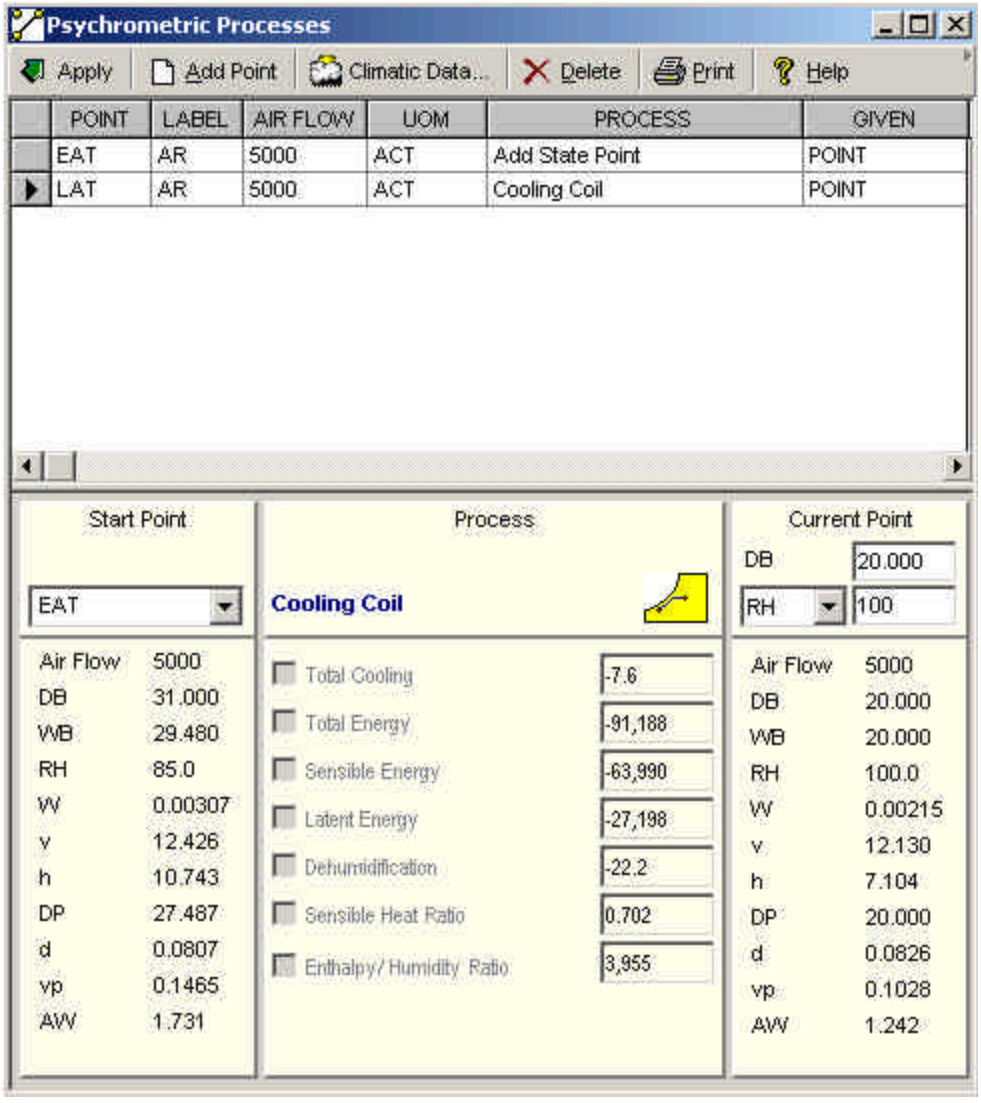
Solution: 51.1 tons



EXAMPLE 3:
Moist Air Cooling & Dehumidification Below Freezing

Problem: Moist air at 31F dry bulb and 85% rh enters a cooling coil at 5,000 cfm and is processed to a final condition at 20F and 100% rh. Find the tons of refrigeration required.

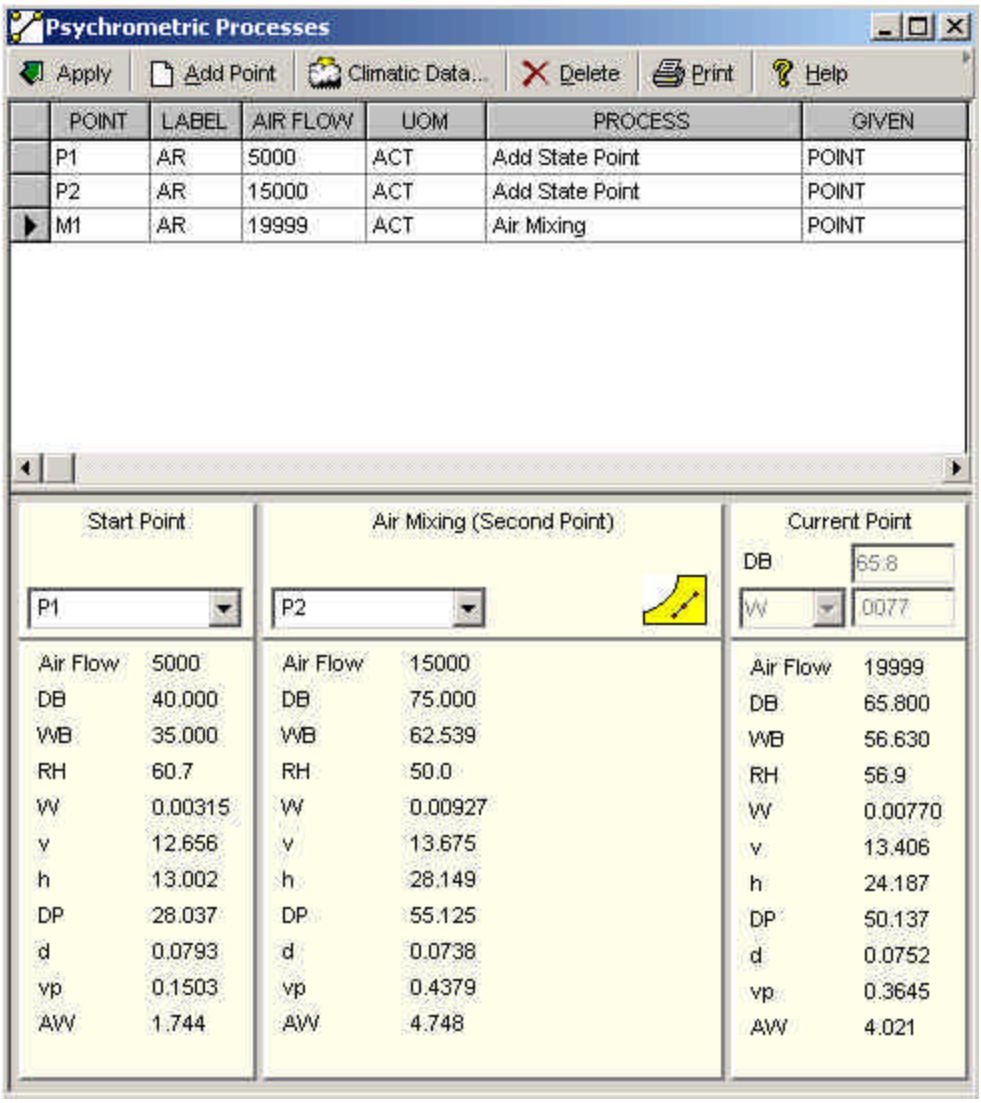
Solution: 7.6 tons



EXAMPLE 4:
Adiabatic Mixing of Two Moist Airstreams

Problem: A stream of 5000 cfm outdoor air at 40F dry-bulb temperature and 35F wet-bulb temperature is adiabatically mixed with 15,000 cfm of 75F dry-bulb temperature air and 50% rh. Find the resulting dry-bulb and wet-bulb temperatures.

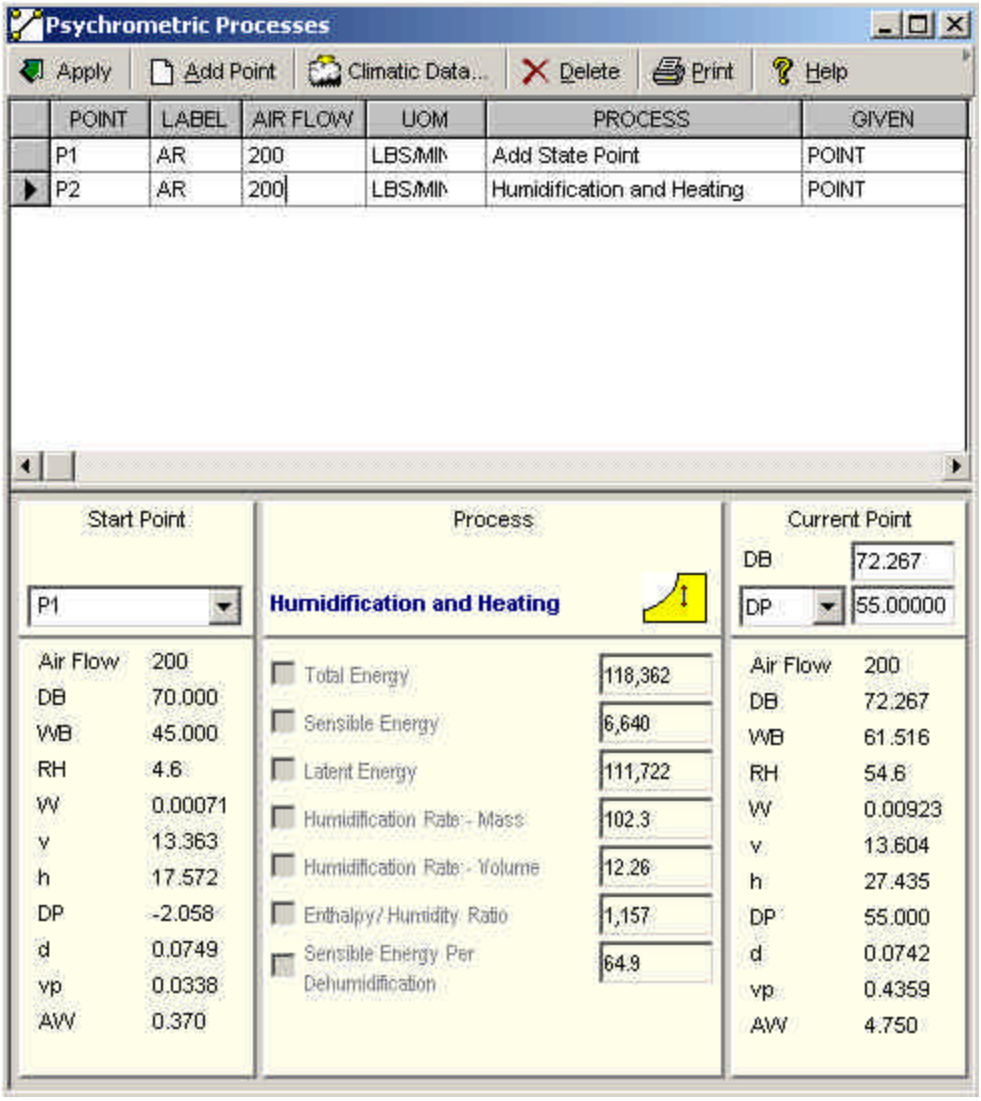
Solution: 65.8°Fdb & 56.6°Fwb



EXAMPLE 5:
Adiabatic Mixing of Water Injected into Moist Air

Problem: Moist Air at 70F dry-bulb and 45F wet-bulb is to be processed to a final dew-point temperature of 55F by adiabatic injection of saturated steam at 230F. The rate of dry airflow is 200lbda/min and the final dry-bulb temperature is 72.267. Find the rate of steam flow required.

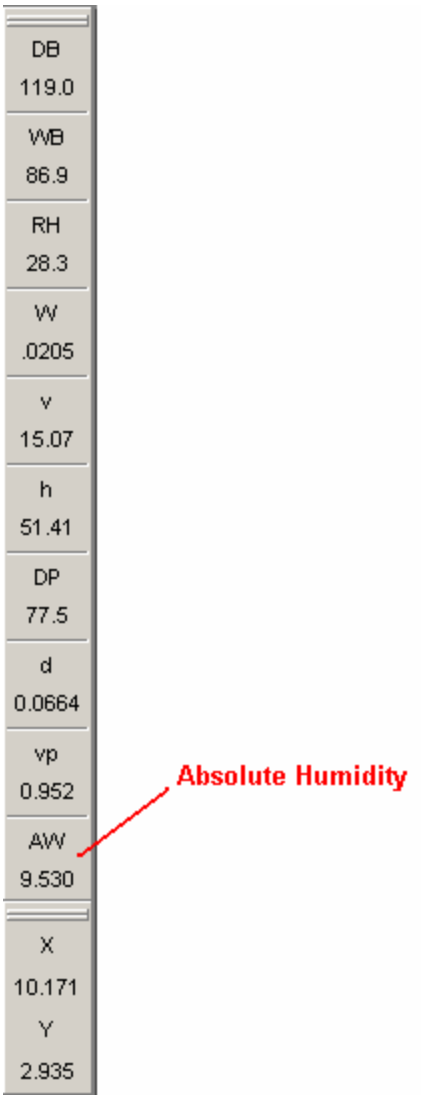
Solution: 102.3 lb/h



TERMINOLOGY

Absolute Humidity

The ratio of the mass of water vapor to the total volume of a sample. The term "water vapor density" is also used for this value.



ASHRAE

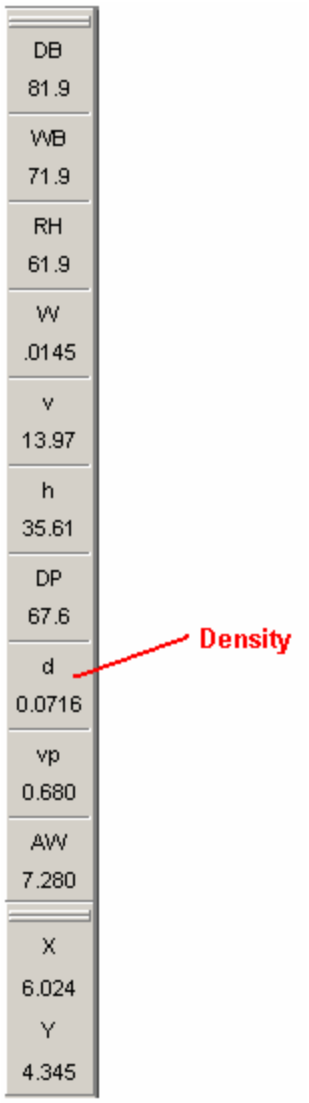
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Atmospheric Air

Air containing water vapor and many gaseous components such as smoke, pollen, gaseous pollutants, etc.

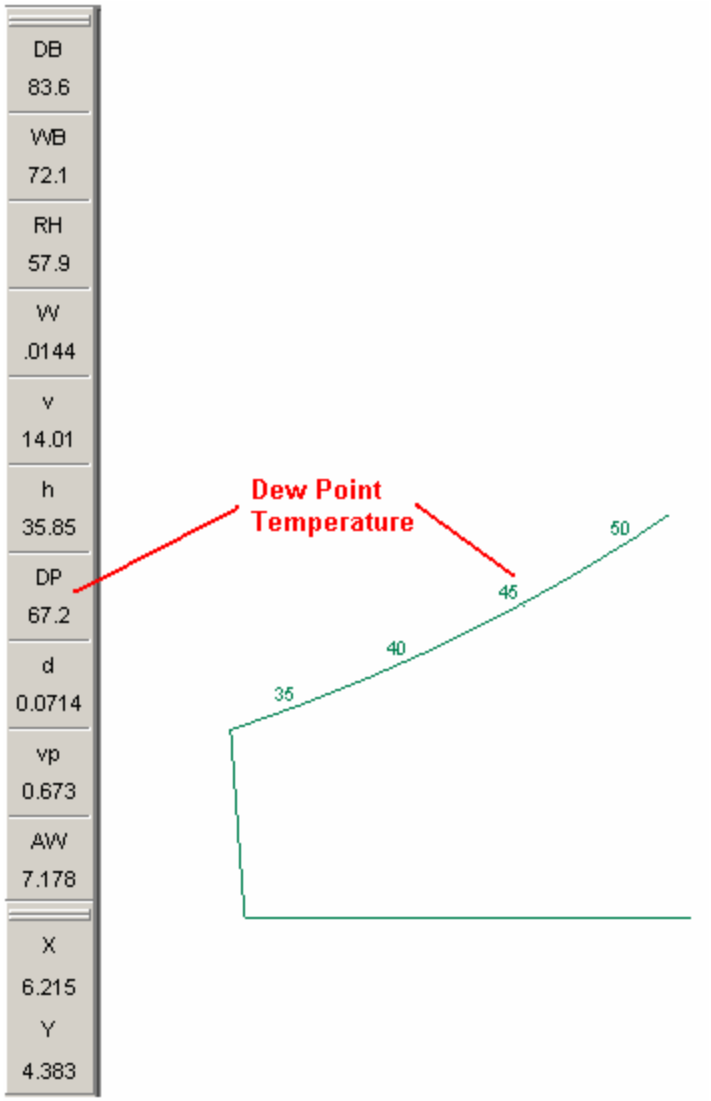
Density

The ratio of the total mass of a sample to the total volume of the sample. For moist air, water vapor and air are included in the totals.



Dew Point Temperature

The temperature of moist air saturated at the same pressure and humidity ratio. Or more simply the temperature at which water vapor will begin to condense from a sample of air.



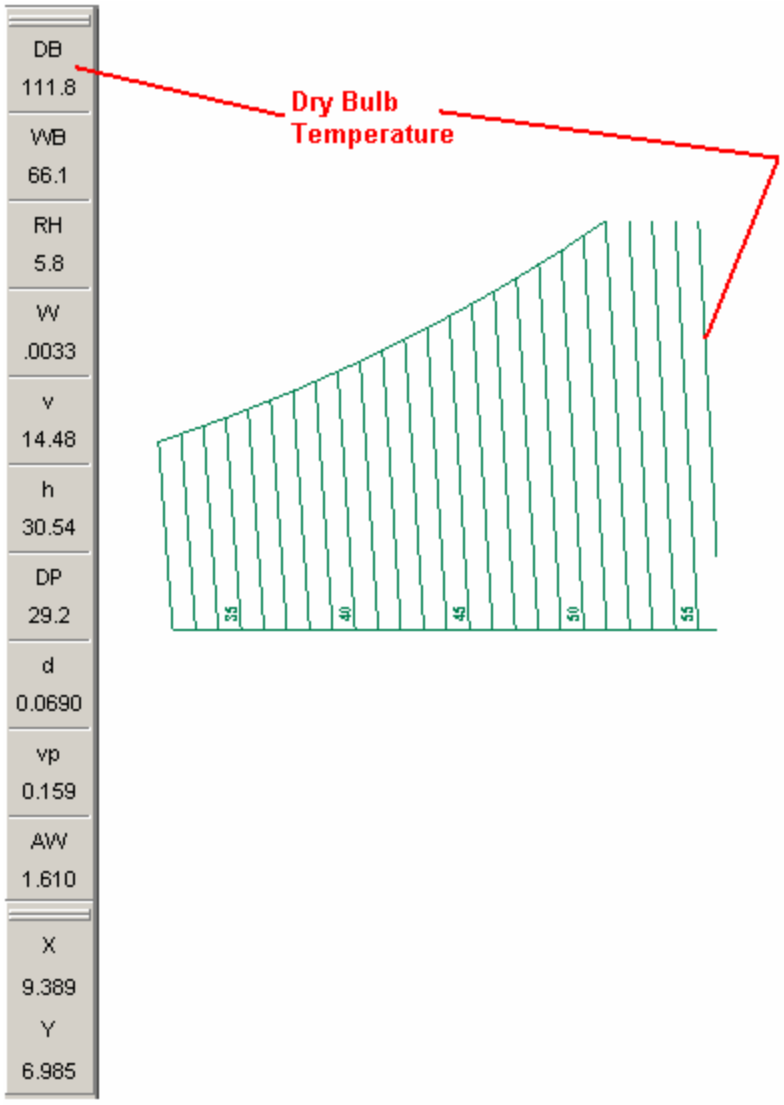
Dry Air

Atmospheric air with all water vapor and contaminants removed.
The approximate percentage by volume of dry air is as follows:

78.084 % Nitrogen
20.9476 % Oxygen
0.934 % Argon
0.0314 % Carbon Dioxide
0.001818 % Neon
0.000524 % Helium
0.00015 % Methane
0.00010 % Sulfer Dioxide
0.00005 % Hydrogen
0.00020 % Other (Krypton, Xenon, Ozone, etc.)

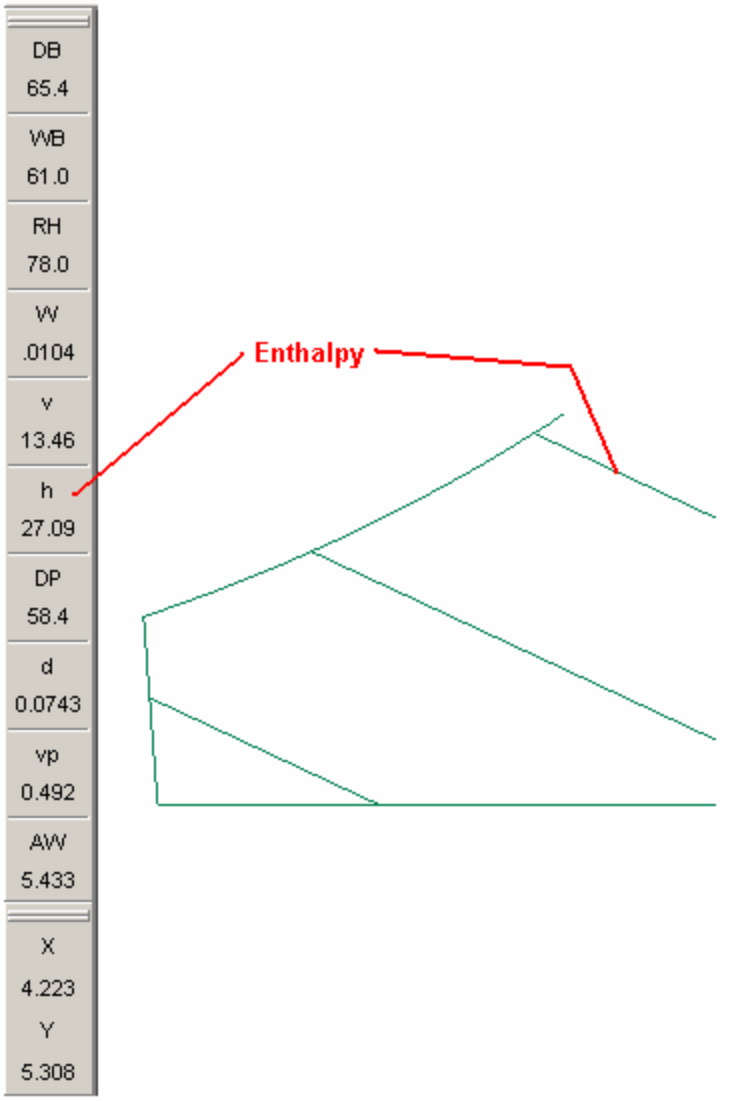
Dry Bulb Temperature

The temperature of air read on a standard thermometer indicating it's thermal state.



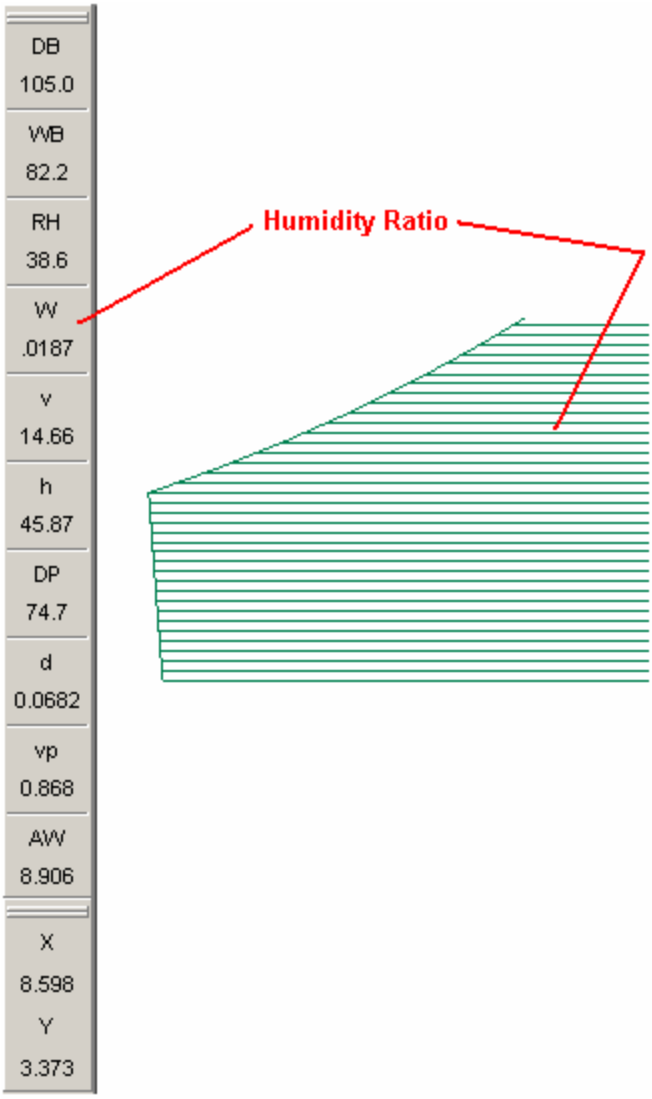
Enthalpy

The thermodynamic property defined as energy per unit mass commonly used to define the internal energy of moist air. The enthalpy of a sample of moist air is the sum of enthalpies of the air and the water vapor. On the psychrometric chart Enthalpy is expressed in terms of energy per weight of DRY air.



Humidity Ratio

The ratio of the mass of water vapor to the mass of dry air of a sample.



Moist Air

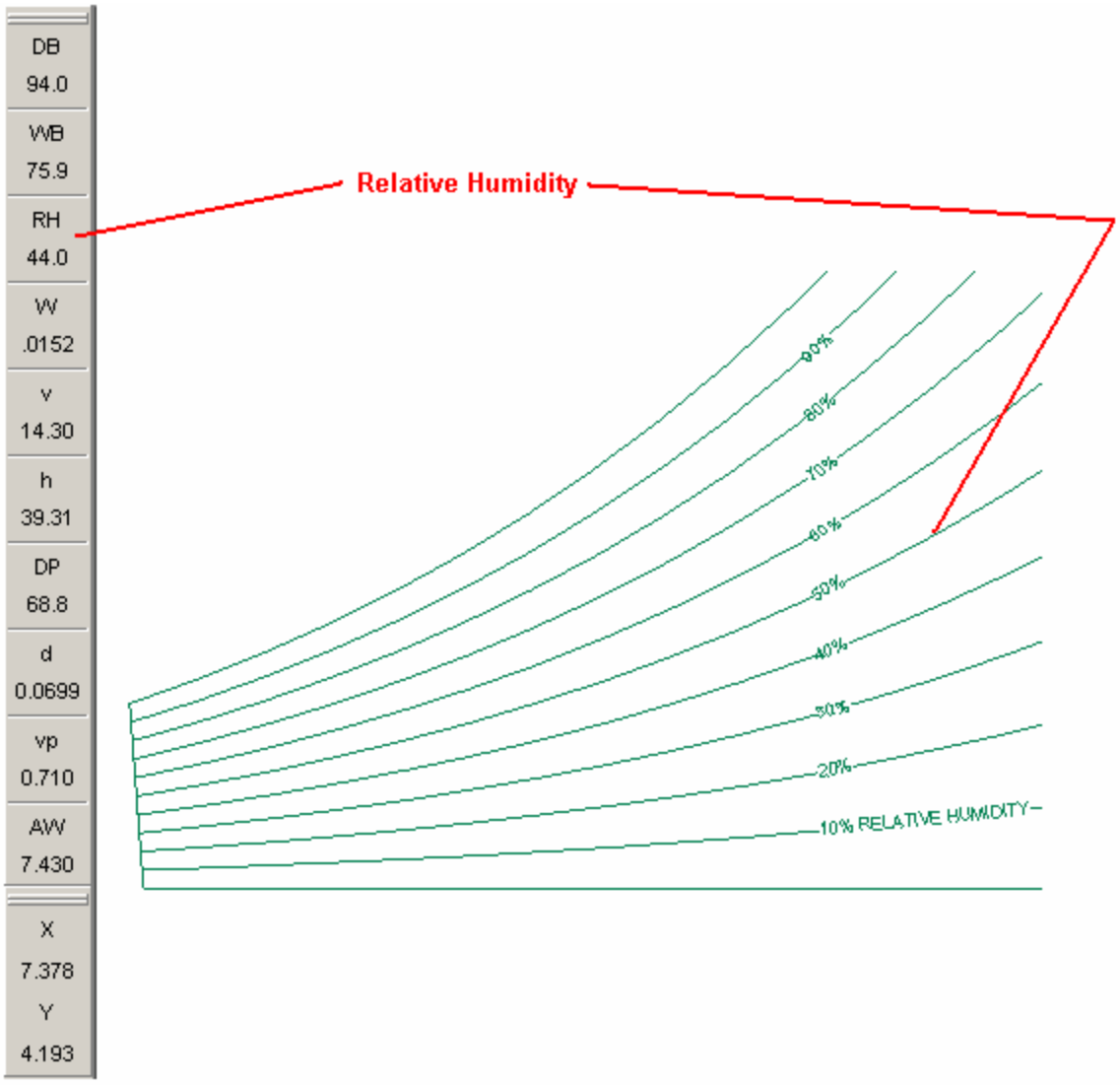
A binary (or two-component) mixture of dry air and water vapor.

Psychrometric Chart

A graphical presentation of the thermodynamic and physical properties of air and water vapor mixtures.

Relative Humidity

The ratio of mole fraction of water vapor in a given moist air sample to the mole fraction in a saturated air sample at the same temperature and pressure.



Saturation

A state of neutral equilibrium between moist air and the condensed water phase (liquid or solid). This state is often referred to as the maximum amount of water vapor in moist air at a given temperature and pressure.

Saturation Humidity Ratio

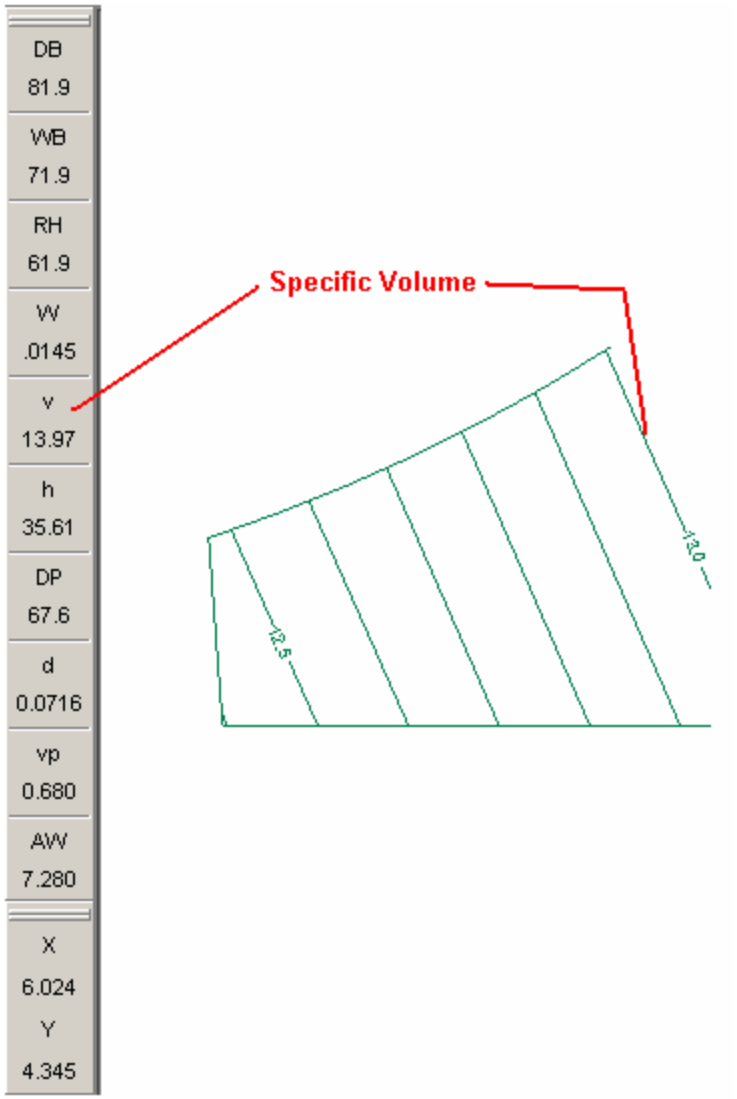
The humidity ratio of moist air saturated with respect to water (or ice) at the same temperature and pressure.

Specific Humidity

The ratio of the mass of water vapor to the total mass of moist air of a sample.

Specific Volume

The ratio of the total volume of air to the mass of dry air in a sample.



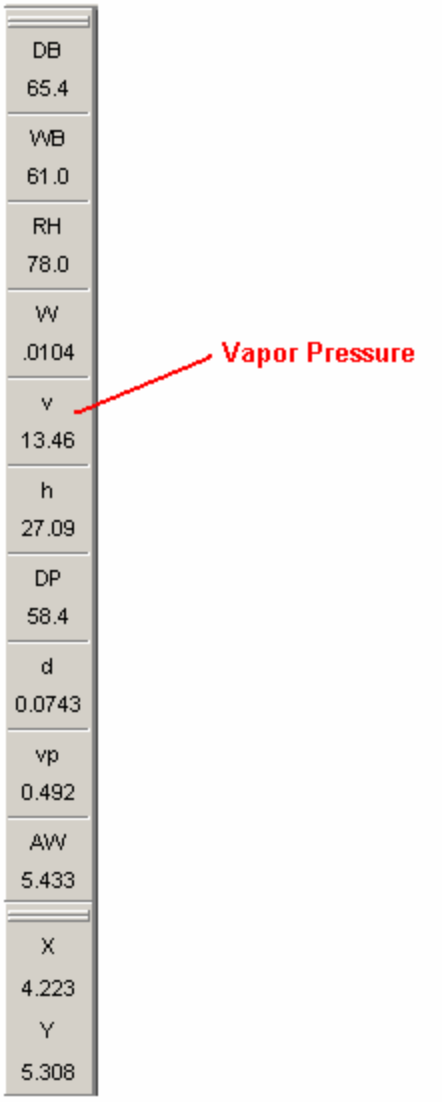
Standard Atmosphere

The standard of reference for estimating properties at various altitudes.

For HVAC purposes standard air is taken as 68°F and 29.921 inches Hg atmospheric pressure.

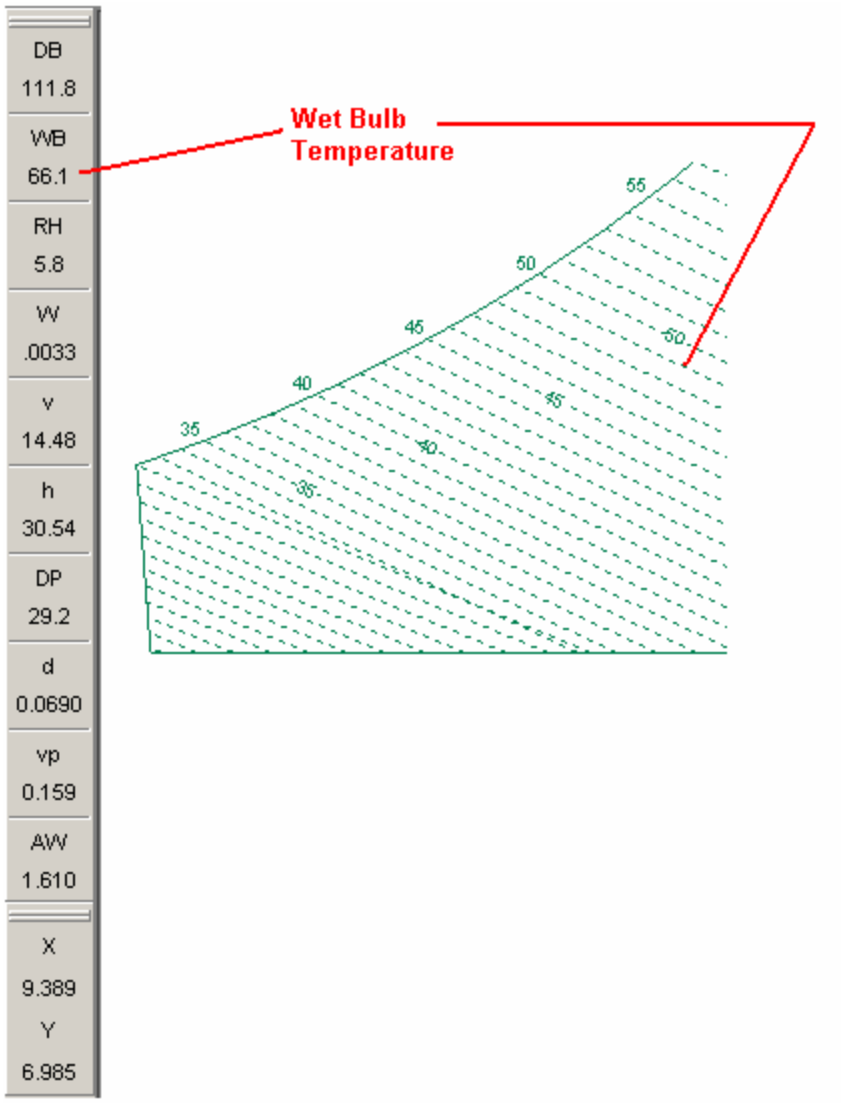
Vapor Pressure

Pressure exerted by a vapor.



Wet Bulb Temperature

The equilibrium temperature reached as water evaporates from a thoroughly wetted psychrometer wick into an airstream. While this process is not one of adiabatic saturation, by applying only small corrections one can obtain the thermodynamic wet-bulb temperature.



PSYCHROMETRIC ALGORITHMS

The following is the methodology the program uses in determining the psychrometric properties of moist air:

Atmospheric Pressure

$$p = Atm \times (1 - 6.8753 \times 10^{-6} \times Z)^{5.2559}$$

p = inches of Mercury

Atm = 29.921299597519

Z = elevation in feet

Water Vapor Saturation Pressure

For 311.67°R <= T =< 491.67°R

$$pws = \exp\left(C_1 \div T + C_2 + C_3 \times T + C_4 \times T^2 + C_5 \times T^3 + C_6 \times T^4 + C_7 \times \ln(T)\right)$$

T = absolute temperature, °R = °F + 459.67

$C_1 = -1.0214165 \times E^4$

$C_2 = -4.8932428 \times E^0$

$C_3 = -5.3765794 \times E^{-3}$

$C_4 = 1.9202377 \times E^{-7}$

$C_5 = 3.5575832 \times E^{-10}$

$C_6 = -9.0344688 \times E^{-14}$

$C_7 = 4.1635019 \times E^0$

For 491.67°R < T =< 851.67°R

$$pws = \exp\left(C_8 \div T + C_9 + C_{10} \times T + C_{11} \times T^2 + C_{12} \times T^3 + C_{13} \times \ln(T)\right)$$

T = absolute temperature, °R = °F + 459.67

$C_8 = -1.0440397 \times E^4$

$C_9 = -1.1294650 \times E^1$

$C_{10} = -2.7022355 \times E^{-2}$

$C_{11} = 1.2890360 \times E^{-5}$

$C_{12} = -2.4780681 \times E^{-9}$

$C_{13} = 6.5459673 \times E^0$

Saturated Humidity Ratio

$$W_s = \frac{0.62198 \times f \times p_{ws}}{p - f \times p_{ws}}$$

p = total pressure of moist air

f = enhancement factor

p_{ws} = pressure of saturated pure water

Enhancement Factor

f = calculated in accordance with Hyland and Wexler (1973, "The Second")

Humidity Ratio

For t^* > 32°F

$$W = \frac{(1093 - 0.556 \times t^*) \times W_s^* - c_p \times (t - t^*)}{1093 + 0.444 \times t - t^*}$$

t^* = thermodynamic wet-bulb temperature of moist air, °F

t = dry-bulb temperature of moist air, °F

c_p = specific heat of moist air, Btu/lb°F

W_s^* = humidity ratio of moist air at saturation at thermodynamic wet-bulb temperature

For t^* <= 32°F

$$W = \frac{(1061 + 0.444 \times t^* - (-143.34 + 0.5 \times (t^* - 32))) \times W_s^* - c_p \times (t - t^*)}{1061 + 0.444 \times t^* - (-143.34 + 0.5 \times (t^* - 32))}$$

t^* = thermodynamic wet-bulb temperature of moist air, °F

t = dry-bulb temperature of moist air, °F

c_p = specific heat of moist air, Btu/lb°F

W_s^* = humidity ratio of moist air at saturation at thermodynamic wet-bulb temperature

Specific Heat

$$c_p = -2.0921943 \times 10^{-14} \times t^4 + 2.5588383 \times 10^{-11} \times t^3 + 1.2900877 \times 10^{-8} \times t^2 + 5.8045267 \times 10^{-6} \times t + 0.23955919$$

t = dry-bulb temperature of moist air, °F

Specific Volume

$$v = \frac{0.7543 \times (t + 459.67) \times (1 + 1.6078 \times W)}{p}$$

t = dry-bulb temperature of moist air, °F

W = humidity ratio of moist air, mass of water per unit mass of dry air

p = total pressure of moist air

Enthalpy

$$h = cp \times t + W \times (1061 + 0.444 \times t)$$

t = dry-bulb temperature of moist air, °F

W = humidity ratio of moist air, mass of water per unit mass of dry air

c_p = specific heat of moist air, Btu/lb°F

Wet Bulb

Iterative calculation calling **Humidity Ratio** function

Dew Point

Iterative calculation calling **Saturated Humidity Ratio** function

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